

E-TENDER SPECIFICATION

S. No.	Package	E- TENDER SPECIFICATION NUMBER
01	Package-A	BHE/PW/PUR/BHFGD-CHIMNEY-PKG-A-U-1/2408
02	Package-B	BHE/PW/PUR/BHFGD-CHIMNEY-PKG-B-U-2/2409

FOR

PACKAGE-A: CIVIL, STRUCTURAL & ARCHITECTURAL WORKS OF 1 NO. CHIMNEY OF 150M OF **UNIT-1 AT 2X250MW NSPCL BHILAI FGD PROJECT, BHILAI, DIST - DURG, CHHATTISGARH**

AND

PACKAGE-B: CIVIL, STRUCTURAL & ARCHITECTURAL WORKS OF 1 NO. CHIMNEY OF 150M OF **UNIT-2 AT 2X250MW NSPCL BHILAI FGD PROJECT, BHILAI, DIST - DURG, CHHATTISGARH**

VOLUME IE – TECHNICAL SPECIFICATION (PART 1 OF 2)

THIS TENDER SPECIFICATION CONSISTS OF:

Notice Inviting Tender	
Volume-IA	Technical Conditions of Contract
Volume-IB	Special conditions of Contract
Volume-IC	General conditions of Contract
Volume-ID	Forms & Procedures
Volume-IE	Technical Specification
Volume II	Price Bid



Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Power Sector - Western Region
345-Kingsway, Nagpur-440001

E-TENDER SPECIFICATION

S. No.	Package	E- TENDER SPECIFICATION NUMBER
01	Package-A	BHE/PW/PUR/BHFGD-CHIMNEY-PKG-A-U-1/2408
02	Package-B	BHE/PW/PUR/BHFGD-CHIMNEY-PKG-B-U-2/2409

FOR

PACKAGE-A: CIVIL, STRUCTURAL & ARCHITECTURAL WORKS OF 1 NO. CHIMNEY OF 150M OF UNIT-1 AT 2X250MW NSPCL BHILAI FGD PROJECT, BHILAI, DIST - DURG, CHHATTISGARH

AND

PACKAGE-B: CIVIL, STRUCTURAL & ARCHITECTURAL WORKS OF 1 NO. CHIMNEY OF 150M OF UNIT-2 AT 2X250MW NSPCL BHILAI FGD PROJECT, BHILAI, DIST - DURG, CHHATTISGARH

EARNEST MONEY DEPOSIT: Refer Notice Inviting Tender

LAST DATE FOR Refer Notice Inviting Tender
TENDER SUBMISSION

THESE TENDER SPECIFICATION DOCUMENTS CONTAINING VOLUME-I AND VOLUME- II ARE ISSUED TO:

M/s.

.....

PLEASE NOTE:
THESE TENDER SPECS DOCUMENTS ARE NOT TRANSFERABLE.

For Bharat Heavy Electricals Limited

AGM (Purchase)

Place: Nagpur

Date:

	TITLE: 2X250 MW BHILAI FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

2X250 MW BHILAI **FGD SYSTEM PACKAGE**

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

(RCC CHIMNEY)

SPECIFICATION NO. PE-TS-468-620-C002
REV-00



Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, PPEI BUILDING, Plot No-25
SECTOR 16A, NOIDA-201301, UP

	TITLE: 2X250 MW BHILAI FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.

	TITLE: 2X250 MW BHILAI FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

INDEX

SECTION	DESCRIPTION

Section-C	SPECIFIC TECHNICAL REQUIREMENTS

Section-D	SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

Sub-section D1: Earthwork in excavation and backfilling

Sub-section D2: Cement concrete (Plain and reinforced) and formwork

Sub-section D3: Carpentry and joinery

Sub-section D4: Roof and underground structures water proofing, insulation and allied works

Sub-section D5: Metal doors, windows, ventilators, louvers etc.

Sub-section D6: Glass and glazing.

Sub-section D7: Rolling Steel Shutter and Grills

Sub-section D8: Miscellaneous Metal

Sub-section D9: Masonry and allied works

Sub-section D10: Finish to masonry and concrete

Sub-section D11: Painting, Whitewashing, polishing

Sub-section D12: Floor finish and allied works

Sub-section D13: Sheet work in roof and siding

Sub-section D14: Suspended ceiling

Sub-section D15: Water supply, drainage & sanitation

Sub-section D16: Road and drainage

Sub-section D17: Fabrication of structural steelwork

Sub-section D18: Erection of structural steelwork

Sub-section D19: Roof decking

Sub-section D20: False flooring

Sub-section D21: Bored cast in situ RCC pile

Sub-section D22: Levelling and grading

	TITLE: 2X250 MW BHILAI FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

Sub-section D23: Anti termite

Sub-section D24: Quality Assurance & Inspection

Sub-section D25: RCC stack

Sub-section D26: Borosilicate glass block lining system

Section-C & SECTION-D CHIMNEY ELECTRICAL AND ELEVATOR ELECTRICAL

Section-C & SECTION-D ELEVATOR MECHANICAL

	TITLE: 2X250 MW BHILAI FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME : IIB
		SECTION : C
		REV.NO. 00
		SHEET

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL WORKS

SPECIFICATION NO. PE-TS-468-620-C002

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			एनटीपीसी NTPC
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			एनटीपीसी NTPC						
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: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures</td><td>: 2.0%</td></tr><tr><td>c) Reinforced concrete structures</td><td>: 1.6%</td></tr></table> : As per IS:6533 & CICIND Model Code whichever is more critical.				a) Welded steel structures	: 1.0%	b) Bolted steel structures	: 2.0%	c) Reinforced concrete structures	: 1.6%
a) Welded steel structures	: 1.0%									
b) Bolted steel structures	: 2.0%									
c) Reinforced concrete structures	: 1.6%									
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 “K _r ” : 1.06			
	c) Category of terrain : Category-2			
7.00.00	FOUNDATION SYSTEM AND GEOTECHNICAL DATA			
7.00.01	Geotechnical data and foundation system for the respective project are enclosed at Annexure-III. The corresponding bore logs are enclosed at Annexure-IV.			
7.00.02	The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.			
7.00.03	The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable.			
7.00.04	Tank Foundations			
	a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any.			
	b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.			
	c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%.			
	d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)
PAGE 9 OF 30				

CLAUSE NO.	PROJECT INFORMATION			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/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 Uplift	Minimum of 2 Nos. in each mode.		
	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		
7.03.00 7.03.01	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to 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. Special Requirements Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 13 OF 30

CLAUSE NO.	PROJECT INFORMATION 		
7.04.00 7.04.01 7.04.02 7.04.03 7.04.04 7.04.05 7.04.06 7.05.00 7.05.01 7.05.02	contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly. Excavation, Filling and Dewatering For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth. Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum. Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices. Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels. CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level. The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches. EXCAVATION IN ROCK Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out. Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type). a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 14 OF 30

CLAUSE NO.	PROJECT INFORMATION			
	as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.00	Geotechnical Investigation The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.			
7.07.01.00	Scheme of geotechnical Investigation			
7.07.02.01	Field test shall include but not be limited to the following: Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.			
7.07.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.			
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)
PAGE 15 OF 30				

CLAUSE NO.	PROJECT INFORMATION														
7.07.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers. Laboratory Tests on Soil Samples Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel. Laboratory Tests on Rock Samples Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.														
7.07.02.05	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards. On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc. Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.														
7.07.03.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies. 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad														
7.08.00	Geotechnical Investigation Scheme a) Boreholes (Minimum) <table><tr><th>S.No</th><th>Structure</th><th>Spacing/Number of borehole</th><th>Depth of borehole</th><th>Remarks</th></tr><tr><td>1</td><td>FGD</td><td>Minimum 14 Nos.</td><td>Depth of boreholes shall be 25m to 35m.</td><td>Depth of boreholes</td></tr></table>					S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of boreholes
S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks											
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				एनटीपीसी NTPC	
	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			
	21°12'10" 81°15'10" 21°22'10" 81°22'10" Existing Plant 21°02'10" 81°15'10" 21°02'10" 81°22'10"			
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	

[illegible]

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 : 296.915m.										DATE OF COMPLETION 17.08.2003				
STARTED 08.08.2003																								
DEPTH IN MT			LITHOLOGY			LOG		PIECES WITH SIZES		STRUCTURAL		SAMPLING/TEST RUN		RECOVERY		ROD(%)		WATER LOSS		COLOUR		SPECIAL		
FROM	TO	DATE	DESCRIPTION	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	
0.00	0.50	08.03	Reddish brown clay with organic materials and kankers										DS											
0.50	1.50	08.03	Reddish brown clay with kankers and gravels										UDS											
1.50	2.25	08.03	Reddish brown clay with kankers and gravels										SPT 4.5, 10 N = 16											
2.25	3.00	08.03	Reddish brown clay with kankers and gravels										DS											
3.00	3.75	08.03	Reddish brown clay with kankers and gravels										UDS/DS											
3.75	4.50	08.03	Yellowish brown clay with kankers and gravels										DS											
4.50	5.25	08.03	Vergated claylatentic clay										SPT 40.40.45 N = 65											
5.25	6.00	08.03	Vergated claylatentic clay										DS											
6.00	6.75	08.03	Vergated claylatentic clay										UDS											
6.75	7.50	08.03	Vergated claylatentic clay										DS											
7.50	8.25	10.8.03	Vergated claylatentic clay										SPT 45, N > 100 10cm pene.											
8.25	9.00	10.8.03	Vergated claylatentic clay										DS											
9.00	9.75	10.8.03	Vergated claylatentic clay										UDS/DS											
9.75	10.50	10.8.03	Vergated claylatentic clay										DS											
10.50	11.25	10.8.03	Vergated claylatentic clay										SPT 50, N > 100 8 cm pene.											
11.25	12.00	11.8.03	Redish brown clay /atentic clay with kankers										DS											
12.00	12.75	11.8.03	Redish brown clay /atentic clay with kankers										UDS											
12.75	13.50	11.8.03	Redish brown clay /atentic clay with kankers										DS											
13.50	14.25	12.8.03	Weathered slaty shale of reddish yellow colour										SPT N > 100											
14.25	15.00	12.8.03	Flak brown coloured lime stone with stromatolitic fossilie										NR											
15.00	15.75	13.8.03	Dark brown coloured lime stone with stromatolitic fossilie			2							CS CR - 21% ROD 20%			20	220							
15.75	16.50	14.8.03	Dark brown coloured lime stone with stromatolitic fossilie			1 2							CS CR - 26% ROD 17%			17	220							
16.50	17.25	14.8.03	Dark brown coloured lime stone with stromatolitic fossilie				1						CS CR - 25% ROD 13%			13	220							
17.25	18.00	14.8.03	Dark brown coloured lime stone with stromatolitic fossilie			1 - 1							CS CR - 28% ROD 17%			17	230							
18.00	18.75	15.8.03	Dark brown coloured lime stone with stromatolitic fossilie			1 - 1							CS CR - 30% ROD NIL			-	250							
18.75	19.50	15.8.03	Dark brown coloured lime stone with stromatolitic fossilie			2 2							CS CR - 32% ROD NIL			-	250							
19.50	20.25	15.8.03	Dark brown coloured lime stone with slaty shale having carbonate vains			1 - 1							CS CR - 40% ROD NIL			-	250							
20.25	21.00	15.8.03	Yellowish slaty shale with carbonate vains			3 1							CS CR - 35% ROD NIL			-	250							
21.00	21.75	16.8.03	Yellowish slaty shale with carbonate vains			3							CS CR - 36% ROD NIL			-	250							
21.75	22.50	16.8.03	Yellowish slaty shale with carbonate vains			1							CS CR - 38% ROD NIL			-	235							
22.50	23.25	16.8.03	Yellowish slaty shale with carbonate vains			1							CS CR - 40% ROD NIL			-	240							
23.25	24.00	16.8.03	Yellowish slaty shale with carbonate vains			2 3							CS CR - 34% ROD NIL			-	235							
24.00	24.75	16.8.03	Yellowish slaty shale with carbonate vains			1 2							CS CR - 36% ROD NIL			-	235							
24.75	25.50	16.8.03	Yellowish slaty shale with carbonate vains			1 - 2							CS CR - 38% ROD NIL			-	230							
25.50	26.25	16.8.03	Yellowish slaty shale with carbonate vains			1 1 1							CS CR - 40% ROD NIL			-	230							
26.25	27.00	16.8.03	Dark brown colour lime stone with stromatolitic fossilie			2 - 4							CS CR - 37% ROD 16%			16	225							
27.00	27.75	16.8.03	Dark brown colour lime stone with stromatolitic fossilie			2 2							CS CR - 38% ROD 18%			18	230							
27.75	28.50	17.8.03	Dark brown colour lime stone with stromatolitic fossilie			3 - 2							CS CR - 42% ROD 22%			22	235							
28.50	29.25	17.8.03	Dark brown colour lime stone with stromatolitic fossilie			2 3 1							CS CR - 44% ROD 24%			24	225							
29.25	30.00	17.8.03	Dark brown colour lime stone with stromatolitic fossilie			1 2							CS CR - 52% ROD 16%			16	180							
THE ROCK IS SPHINTERARY SOFT WEATHERED ALSO CORE SAMPLE BREAK FROM THE CARBONATE VE PART OF A SAMPLE. THE IS ALTERNATE LAYER OF LIME STONE AND SHALE. WATER LOSS IS ENCOUNTERED AT 20 MTR. THE END.																								

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

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 33										LOCATION : MAIN PLANT AREA PP 2										TOTAL DEPTH : 30 MTR.				
BEARING OF HOLE : -										CD ORDNATES : X 1700 Y 9400										GROUND WATER TABLE : 1 MTR. SEEPAGE WATER				
COLLAR ELEVATION : -										TYPE OF USED (WITH DEPTH) : DIAMOND										TYPE OF CORE BARREL USED : DOUBLE TUBE				
STARTED : 02.09.2002										GROUND RL : 289.744										DATE OF COMPLETION : 09.09.02				
MT		DATE		LITHOLOGY		PIECES WITH SIZES		STRUCTURAL		SAMPLING/TEST RUN		RECOVERY		ROD (%)		WATER LOSS		NO PARTIAL		R OF		SPECIAL		
FROM	TO			DESCRIPTION	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	LOG	
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							UCS/DS													
0.50	1.50	3.9.03		Reddish brown clay with lankers and gravels							SPT 7,12,19 H-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 12,16,23 H-41													
4.50	5.25	4.9.03		Reddish brown clay with lankers and gravels							DS													
5.25	6.00	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							DS													
6.00	6.75	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							DS													
6.75	7.50	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							DS													
7.50	9.00	5.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 40 ROD NIL				-	190								
9.00	10.50	5.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 37 ROD NIL				-	190								
10.50	12.00	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 36 ROD NIL				-	190								
12.00	13.50	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 42 ROD NIL				-	160								
13.50	15.00	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins			3	1	-	-	CS CR - 60 ROD NIL				-	200								
15.00	16.50	6.9.03		Dark brown colour lime stone with stromatolitic fossil impression along with grayish slaty shale having carbonate veins			5	8	2	-	CS CR - 60 ROD 26%					26	200							
16.50	18.00	6.9.03		Grayish slaty shale with carbonate veins			6	6	3	-	CS CR - 90 ROD 15%					15	190							
18.00	19.50	7.9.03		Grayish slaty shale with carbonate veins			5	4	3	-	CS CR - 91 ROD 28%					28	190							
19.50	21.00	7.9.03		Grayish slaty shale with carbonate veins			4	3	1	-	CS CR - 76 ROD 14%					14	180							
21.00	22.50	7.9.03		Grayish slaty shale with carbonate veins			3	1	6	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 along with Dark brown colour lime stone with 55 cm. Length			2	3	-	1	CS CR - 88 ROD 38%					38	220							
28.50	30.00	9.9.03		Grayish slaty shale with carbonate veins			6	4	1	-	CS CR - 90 ROD 34%					34	200							

THE ROCK IS SEDIMENTARY SOFT AND WEATHERED. YELLOWISH GREEN SLATY SHALE IS FOUND IN THIS BORE WITH FOSSIL IMPRESSIONS AND CARBONATE VEINS. LIME STONE PATCH OF 55 CM. HAS BEEN ENCOUNTERED AT A DEPTH OF 16 MTRS. WHICH IS A REGULAR FEATURE OF THIS BORE HOLE. IN THIS BORE HOLE ROCK HAS BEEN ENCOUNTERED AT A DEPTH OF 7.50 MTRS.

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 -										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 09.09.03				
STARTED 03.09.2003																								
MT			LITHOLOGY		LOG		PIECES WITH SIZES		STRUCTURAL		SAMPLING/TEST		RECOVERY		ROD (%)		WATER LOSS		R OF		SPECIAL			
FROM	TO	DATE	DESCRIPTION	LOG	10	5	2	1	LOG	DESCRIPTION	ST/RUN	20	40	60	80	100	ROD (%)	CASING	NO PARTIAL	ROD WASH	ROD WASH	ROD WASH		
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								UDS/DS													
0.50	1.50	3.9.03	Reddish brown clay with lankers and gravels								SPT 7,12,19 N -31													
1.50	2.25	3.9.03	Reddish brown clay with lankers and gravels								UDS													
2.25	3.00	4.9.03	Reddish brown clay with lankers and gravels								DS													
3.00	3.75	4.9.03	Reddish brown clay with lankers and gravels								DS													
3.75	4.50	4.9.03	Reddish brown clay with lankers and gravels								SPT 12,18,23 N-41													
4.50	5.25	4.9.03	Reddish brown clay with lankers and gravels								DS													
5.25	6.00	4.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								DS													
6.00	6.75	4.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								DS													
6.75	7.50	4.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								DS													
7.50	9.00	5.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								CS CR - 40 ROD NIL													
9.00	10.50	5.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								CS CR - 37 ROD NIL													
10.50	12.00	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								CS CR - 36 ROD NIL													
12.00	13.50	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								CS CR - 42 ROD NIL													
13.50	15.00	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins								CS CR - 60 ROD NIL													
15.00	16.50	6.9.03	Dark brown colour lime stone with stromatolitic fossil impression alongwith grayish slaty shale having carbonate veins								CS CR - 80 ROD 26%													
16.50	18.00	6.9.03	Grayish slaty shale with carbonate veins								CS CR - 90 ROD 15%													
18.00	19.50	7.9.03	Grayish slaty shale with carbonate veins								CS CR - 91 ROD 28%													
19.50	21.00	7.9.03	Grayish slaty shale with carbonate veins								CS CR - 76 ROD 14%													
21.00	22.50	7.9.03	Grayish slaty shale with carbonate veins								CS CR - 92 ROD 34%													
22.50	24.00	8.9.03	Grayish slaty shale with carbonate veins								CS CR - 93 ROD 45%													
24.00	25.50	8.9.03	Grayish slaty shale with carbonate veins								CS CR - 90 ROD 56%													
25.50	27.00	8.9.03	Grayish slaty shale with carbonate veins								CS CR - 96 ROD 62%													
27.00	28.50	9.9.03	Grayish slaty shale with carbonate veins alongwith Dark brown colour lime stone with 55 cm. Legnth								CS CR - 88 ROD 36%													
28.50	30.00	9.9.03	Grayish slaty shale with carbonate veins								CS CR - 90 ROD 34%													

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

TABLE - 2
LIGHT DIESEL OIL CHARACTERISTICS
AS PER IS 1460-2000

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 for 3 hours at 100°C	Not worse than No. 2
10.	Water content, % by volume(max)	0.25
11.	GCV (Kcal/kg)	10,000

**TABLE - 2
FUEL OIL CHARACTERISTICS**

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	-

Table-3 NOT USED

Table-4

DESIGN CLARIFIED WATER ANALYSIS

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

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

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

CLAUSE NO.	PROJECT INFORMATION		एनटीपीसी NTPC																																																			
	Table-6 STEAM GENERATOR DATA <table><tr><td>1.</td><td>Location</td><td>Outdoor</td></tr><tr><td>2.</td><td>Operation</td><td>Base load</td></tr><tr><td>3.</td><td>Type</td><td>Pulverized coal fired</td></tr><tr><td>4.</td><td>Maximum Continuous Rating</td><td>790 Tonns/hr.</td></tr><tr><td>5.</td><td>Steam pressure at SH outlet</td><td>155 Kg/cm²(a)</td></tr><tr><td>6.</td><td>Steam temperature at SH outlet</td><td>540°C</td></tr><tr><td>7.</td><td>Oil for startup and flame stabilization</td><td>LDO</td></tr><tr><td>8.</td><td>Fuel oil system sizing</td><td>7.5% of Boiler MCR for start-up by LDO, 40% of Boiler MCR by HFO</td></tr><tr><td>9.</td><td>Pulverised coal size and 99% thru 50 mesh</td><td>Minimum 70% through 200 Mesh</td></tr><tr><td>10.</td><td>Type of pulveriser</td><td>Vertical spindle mills</td></tr><tr><td>11.</td><td>Type of oil burners</td><td>Air atomized for LDO</td></tr><tr><td>12.</td><td>No. of air heaters</td><td>One</td></tr><tr><td>13.</td><td>No. of ID Fans</td><td>Two (both working)</td></tr></table> ESP DATA <table><tr><td>1.</td><td>Location:</td><td>Downstream side of Air preheaters</td></tr><tr><td>2.</td><td>Operation:</td><td>Base load</td></tr><tr><td>3.</td><td>Type:</td><td>Rigid Discharge frame</td></tr><tr><td>4.</td><td>Rapping:</td><td>Intermittent</td></tr></table>			1.	Location	Outdoor	2.	Operation	Base load	3.	Type	Pulverized coal fired	4.	Maximum Continuous Rating	790 Tonns/hr.	5.	Steam pressure at SH outlet	155 Kg/cm ² (a)	6.	Steam temperature at SH outlet	540°C	7.	Oil for startup and flame stabilization	LDO	8.	Fuel oil system sizing	7.5% of Boiler MCR for start-up by LDO, 40% of Boiler MCR by HFO	9.	Pulverised coal size and 99% thru 50 mesh	Minimum 70% through 200 Mesh	10.	Type of pulveriser	Vertical spindle mills	11.	Type of oil burners	Air atomized for LDO	12.	No. of air heaters	One	13.	No. of ID Fans	Two (both working)	1.	Location:	Downstream side of Air preheaters	2.	Operation:	Base load	3.	Type:	Rigid Discharge frame	4.	Rapping:	Intermittent
1.	Location	Outdoor																																																				
2.	Operation	Base load																																																				
3.	Type	Pulverized coal fired																																																				
4.	Maximum Continuous Rating	790 Tonns/hr.																																																				
5.	Steam pressure at SH outlet	155 Kg/cm ² (a)																																																				
6.	Steam temperature at SH outlet	540°C																																																				
7.	Oil for startup and flame stabilization	LDO																																																				
8.	Fuel oil system sizing	7.5% of Boiler MCR for start-up by LDO, 40% of Boiler MCR by HFO																																																				
9.	Pulverised coal size and 99% thru 50 mesh	Minimum 70% through 200 Mesh																																																				
10.	Type of pulveriser	Vertical spindle mills																																																				
11.	Type of oil burners	Air atomized for LDO																																																				
12.	No. of air heaters	One																																																				
13.	No. of ID Fans	Two (both working)																																																				
1.	Location:	Downstream side of Air preheaters																																																				
2.	Operation:	Base load																																																				
3.	Type:	Rigid Discharge frame																																																				
4.	Rapping:	Intermittent																																																				
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																																																			

Table-7

List of Drawings placed below in this sub section:

S.N.	Drawing Description	Drawing No.
1.	General Layout Plan	Enclosed
2.	Topography	Enclosed
3.	Contour Drawing	Enclosed
4.	Main Plant Equipment Layout	Enclosed
5.	ID system-Elevation & Plan	Enclosed
6.	Pipe Cable Trestle Layout	Enclosed
7.	Pipe Cable Trestle Foundation	Enclosed
8.	Chimney foundation details	(Unit 1&2)
	i. Chimney shell outer Diameter at ground level (m)	22.74
	ii. Chimney foundation outer diameter (m)	36.9
	iii. Type of foundation	Piled Raft Foundation
	iv. Level of Bottom of foundation (m)	RL(+)290.18
	v. Level of Top of foundation (m)	RL(+)293.5

NTPC Limited

(A Government of India Enterprise)



LOT 2 PROJECTS

(PART –A)

SECTION – VI

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

BIDDING DOCUMENT NO.: CS-0011-109(2)-9

NTPC Limited

(A Government of India Enterprise)



LOT 2 PROJECTS

(PART –A)

SECTION – VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(2)-9

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.



FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(2)-9

LIST OF LOT 2 PROJECTS

1. TALCHER STPS, STAGE-I & II (2x500 MW + 4x500 MW)
2. SIMHADRI STPS, STAGE-I & II (2x500 MW + 2x500 MW)
3. SIPAT STPS, STAGE-I (3x660 MW)
4. NTECL VALLUR TPS (3x500 MW)
5. NSPCL BHILAI EXPANSION POWER PROJECT (2x250 MW)
6. KBUNL MUZAFFARPUR TPS, STAGE-II (2x195 MW)
7. NSPCL ROURKELA PP-II EXPANSION POWER PROJECT (1x250 MW)

LOT-2 PROJECTS

SECTION - VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS

PART – A

SUB-SECTION-I	INTENT OF SPECIFICATION
SUB-SECTION-II	PROJECT INFORMATION
SUB-SECTION-II-A1	TALCHER STPS, STAGE-I & II (2x500 MW + 4x500 MW)
SUB-SECTION-II-A2	SIMHADRI STPS, STAGE-I & II (2x500 MW + 2x500 MW)
SUB-SECTION-II-A3	SIPAT STPS, STAGE-I (3x660 MW)
SUB-SECTION-II-A4	NTECL VALLUR TPS (3x500 MW)
SUB-SECTION-II-A5	NSPCL BHILAI EXPANSION POWER PROJECT (2x250 MW)
SUB-SECTION-II-A6	KBUNL MUZAFFARPUR TPS, STAGE-II (2x195 MW)
SUB-SECTION-II-A7	NSPCL ROURKELA PP-II EPP (1x250 MW)
SUB-SECTION-III	SCOPE OF SUPPLY & SERVICES
SUB-SECTION-III-A	MECHANICAL EQUIPMENTS & SYSTEMS
SUB-SECTION-III-A1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-III-A2	AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM
SUB-SECTION-III-A3	FIRE DETECTION & PROTECTION SYSTEM
SUB-SECTION-III-A4	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-III-A5	LIMESTONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-III-B	ELECTRICAL SYSTEM/EQUIPMENT
SUB-SECTION-III-C	CONTROL AND INSTRUMENTATION SYSTEM
SUB-SECTION-III-D	CIVIL WORKS
SUB-SECTION-IV	TERMINAL POINTS & EXCLUSIONS
SUB-SECTION-V	SALIENT DESIGN DATA

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

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(2)-9

SUB-SECTION-VI	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
SUB-SECTION-VII	MANDATORY SPARES

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-I-M (MECHANICAL SYSTEM)

SUB-SECTION-I-M1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-I-M2	AIR CONDITIONING & VENTILATION SYSTEM
SUB-SECTION-I-M3	COMPRESSED AIR SYSTEM
SUB-SECTION-I-M4	FIRE DETECTION & PROTECTION SYSTEM
SUB-SECTION-I-M5	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-I-M6	LIMESTONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-I-M7	PIPING
SUB-SECTION-I-M8	MDL

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-II-E (ELECTRICAL SYSTEM)

SUB-SECTION-II-E1	GENERAL ELECTRICAL SPECIFICATION
SUB-SECTION-II-E2	MOTORS
SUB-SECTION-II-E3	MEDIUM VOLTAGE BUS DUCTS
SUB-SECTION-II-E4	LT POWER CABLES
SUB-SECTION-II-E5	LT CONTROL CABLES
SUB-SECTION-II-E6	CABLING EARTHING & LIGHTNING PROTECTION
SUB-SECTION-II-E7	HT CABLES
SUB-SECTION-II-E8	NOT USED
SUB-SECTION-II-E9	HT SWITCHGEAR
SUB-SECTION-II-E10	LT SWITCHGEAR & LT BUSDUCT
SUB-SECTION-II-E11	DIESEL GENERATORS
SUB-SECTION-II-E12	TRANSFORMERS

SUB-SECTION-II-E13	ELEVATOR ELECTRICAL
SUB-SECTION-II-E14	FIRE PROOF CABLE PENETRATION SEALING SYSTEM
SUB-SECTION-II-E15	LIGHTING
SUB-SECTION-II-E16	BATTERY
SUB-SECTION-II-E17	BATTERY CHARGER
SUB-SECTION-II-E18	VFD
SUB-SECTION-II-E19	SWITCHYARD ELECTRICAL
SUB-SECTION-II-E20	CONTROL AND PROTECTION
SUB-SECTION-II-E21	ELECTRICAL WORKS FOR CHIMNEY

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-III-C (CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-III-C1	BASIC DESIGN CRITERIA
SUB-SECTION-III-C2	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)
SUB-SECTION-III-C3	PROCESS CONNECTION AND PIPING
SUB-SECTION-III-C4	INSTRUMENTATION CABLES
SUB-SECTION-III-C5	DDCMIS
SUB-SECTION-III-C6	TYPE TEST REQUIREMENTS
SUB-SECTION-III-C7	CONTROL VALVES, ACTUATORS & ACCESSORIES
SUB-SECTION-III-C8	ELECTRIC ACTUATOR
SUB-SECTION-III-C9	CONTROL DESK, PANEL AND FURNITURE
SUB-SECTION-III-C10	POWER SUPPLY
SUB-SECTION-III-C11	CONTAINERISED ROOM (PORTABLE CABIN)

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D	CIVIL WORKS

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- V-Q (QUALITY ASSURANCE)

(MECHANICAL)

SUB-SECTION-V-QM1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-V-QM2	LIME & GYPSUM HANDLING
SUB-SECTION-V-QM3	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-V-QM4	AIR CONDITIONING & VENTILATION
SUB-SECTION-V-QM5	COMPRESSOR AIR SYSTEM
SUB-SECTION-V-QM6	FIRE DETECTION & PROTECTION SYSTEM

(ELECTRICAL)

SUB-SECTION-V-QE1	MOTORS
SUB-SECTION-V-QE2	MEDIUM VOLTAGE BUS DUCTS
SUB-SECTION-V-QE3	LT POWER CABLES
SUB-SECTION-V-QE4	CONTROL CABLES
SUB-SECTION-V-QE5	CABLING EARTHING & LIGHTNING PROTECTION
SUB-SECTION-V-QE6	HT CABLES
SUB-SECTION-V-QE7	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS
SUB-SECTION-V-QE8	HT SWITCHGEAR
SUB-SECTION-V-QE9	LT SWITCHGEAR
SUB-SECTION-V-QE10	DIESEL GENERATORS
SUB-SECTION-V-QE11	AUXILIARY TRANSFORMERS
SUB-SECTION-V-QE12	ELEVATOR
SUB-SECTION-V-QE13	VFD MODULE
SUB-SECTION-V-QE14	STATION LIGHTING
SUB-SECTION-V-QE15	SWITCHYARD
SUB-SECTION-V-QE16	POWER TRANSFORMER

(CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-V-QC1	MEASURING INSTRUMENTS
	(PRIMARY & SECONDARY
SUB-SECTION-V-QC2	PROCESS CONNECTION & PIPING
SUB-SECTION-V-QC3	INSTRUMENTATION CABLES
SUB-SECTION-V-QC4	CONTROL DESK
SUB-SECTION-V-QC5	POWER SUPPLY SYSTEM
SUB-SECTION-V-QC6	CONTROL VALVE ACTUATORS AND ACCESSORIES
SUB-SECTION-V-QC7	ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS
SUB-SECTION-V-QC8	DDCMIS

(CIVIL WORKS)

SUB-SECTION-V-QD1

SUB-SECTION- VI

(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS)

PART - C

GENERAL CONDITIONS OF CONTRACT

PART - D

ERECTION CONDITIONS OF CONTRACTS

PART - E

LIST OF TENDER DRAWINGS

PART - F

ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)

PART – A

SUB-SECTION-I

INTENT OF SPECIFICATION

CLAUSE NO.	INTENT OF SPECIFICATION		
1.00.00 1.01.00	INTENT OF SPECIFICATION Scope of the proposal The scope of the proposal for Engineering, Supply, Construction, Erection, Testing & Commissioning works for each project of Flue Gas Desulphurisation (FGD) System Package for Lot 2 Projects shall be on the basis of a single point responsibility, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with “Scope of Supply & Services”, Sub-section-III, Part-A, Section – VI of Technical Specification. a) Basic Engineering of the plant including preparation of Plant Definition Manuals for the Project; b) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope for the Project. c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information; d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required; e) Complete manufacturing including shop testing/type testing; f) Complete Civil, Structural and Architectural works, including survey, providing construction offices, field laboratory and construction equipments; g) Packing and transportation from the manufacturer's works to the site including customs clearance & port clearance, port charges, if any. h) Receipt, storage, preservation, handling and conservation of equipment at the site; i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation; j) Reliability tests, performance and guarantee tests after successful completion of facilities; k) Furnishing of spares on FOR site basis; l) Reconciliation with customs authorities, as required.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 1 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
1.02.00	m) Satisfactory conclusion of the contract. n) Insurance and other requirements for the complete FGD package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document. The requirements, conditions, appendices etc. given in Technical Specifications (Section-VI, Parts A, B, C, D, E & F) and shall apply to and shall be considered as a part of this volume as completely as if bound here with. The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification (Section VI) as completely as if bound herewith. The Contractor shall be responsible for providing all material, equipment and service, which are required to fulfill 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. It is not the intent to specify completely herein, all aspects of design and construction of equipment, nevertheless, the equipment shall conform in all aspects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Employer, who will interpret the meaning of the specification, drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable international standards mentioned elsewhere in the specification. Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specification. Before, submitting their offer, Bidder is required to visit the Project site for assessing the feasibility & layout for FGD System. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the Conditions of Contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Employer in writing before the award of this contract, based on a written request from the Bidder for such a clarification. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately. The Bidder may also make alternate offers provided, such offers are superior in his opinion, to the requirements of these specifications in which case, adequate technical information, operating feed back, etc., are to be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption etc., shall be clearly brought out for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the specified equipment and services shall be brought out as an alternative offer.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 2 OF 21	

CLAUSE NO.	INTENT OF SPECIFICATION			
1.03.00 1.03.01 1.03.02 1.03.03 1.03.04 1.03.05 1.03.06 1.03.07 1.03.08 1.03.09 1.04.00	In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection. The following are the equipment's covered in this specification: Wet limestone based Flue gas desulphurization (FGD) for the project, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler, complete with all accessories and auxiliary equipment's as per specification requirements including Booster Fans for each unit, Absorber for each unit with Slurry re-circulation pumps & Oxidation blowers, common Limestone Grinding & slurry preparation system, common Gypsum dewatering system, Limestone handling and storage system, Gypsum handling and storage system. One (1) number of elevator for each absorber of height more than 20 M and One (1) numbers of elevator for Limestone Grinding System building. Sheds for Slurry re-circulation pumps/Oxidation blowers and Buildings for Limestone Grinding System, Compressors, Gypsum dewatering system & FGD control Room. ECW system, PT plant, SWRO, UF and its associated system such as RO skid, UF skids, Air Scoring system, Backwashing system, Chemical dosing system, CIP, Flushing system etc., complete facilities and equipment like pumps, blowers, pipings, tanks, valves etc. for such system(s) shall be under the scope of the contractor for Vallur TPP (3x500 MW). ECW system, PT plant, Chemical dosing system, complete facilities and equipment like pumps, blowers, piping, tanks, valves etc. for such system(s) shall be under the scope of the contractor for Simhadri STPP. All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc. Low Height Wet Chimney(s) for the project (except Rourkela Project for which the Wet Chimney under construction is to be used) Associated Control & Instrumentation (C&I) equipments. Associated Civil, Structural and Architectural works including foundation as specified in Technical Specification. Wherever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood to be descriptive only and not restrictive. Such description indicates the equipment type, function and quality desired. Other manufacturer's products may be considered provided sufficient information so as to enable the Employer to determine that the products proposed are equivalent to those named.			
	LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 3 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
2.00.00	Additional Requirements (a) Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer. (b) Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the contractor at his own cost to the satisfaction of the Employer. The contractor shall also take all necessary safety measures with specific reference to excavation in rock, at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power plant. (c) For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Porta cabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look. (d) In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. (e) Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements / tie up with equipment manufacturers / suppliers for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 4 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
3.00.00	APPLICABLE DRAWINGS			
	The drawings listed below and forming part of the specification (Refer Part-E) shall supplement the requirements specified herein. The scope and terminal points of the equipment to be furnished under this Flue Gas Desulphurisation package shall be as identified in these drawings and read in conjunction with text of the specification.			
	(A) SCHEMES			
	Sl. No	Drawings Title	Drawings No.	No. of Sheets
	1)	Scheme of Absorber system	0011-109(2)-POM-A-001	3
	2)	Scheme of Limestone Milling system	0011-109(2)-POM-A-002	1
	3)	Scheme of Gypsum De-watering system	0011-109(2)-POM-A-003	1
	4)	P&ID Diagram for ECW System of FGD	0011-109(2)-POM-A-004	1
	5)	P&ID for Pre-Treatment Plant (Sheet-1) for Simhadri STPP	0011-109(2)-POM-A-005	2
		P&ID Diagram for ECW System of FGD (Sheet-2) for Simhadri STPP		
6)	P&ID for Pre-Treatment Plant & RO Plant (Sheet-1 to 6) for Vallur TPP	0011-109(2)-POM-A-006	7	
	P&ID Diagram for ECW System of FGD (Sheet-7) for Vallur TPP			
7)	Compressed Air System	0011-109(2)-POM-A-007	1	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 5 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION 																																																		
	(B) CONTROL & INSTRUMENTATION <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Drawings Title</th><th>Drawings No.</th><th>No. of Sheets</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Standard configuration diagram for control system</td><td>0000-151-POI-A-013</td><td>1</td></tr> <tr> <td>2.</td><td>G.A. of Junction Box</td><td>0000-999-POI-A-017</td><td>1</td></tr> <tr> <td>3.</td><td>Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply</td><td>0000-999-POI-A-019A</td><td>2</td></tr> <tr> <td>4.</td><td>Scheme of 24V DC Power supply system</td><td>0000-999-POI-A-019B</td><td>1</td></tr> <tr> <td>5.</td><td>Scheme for Uninterruptible Power Supply System</td><td>0000-999-POI-A-019C</td><td>1</td></tr> <tr> <td>6.</td><td>Instrumentation/control/power supply cabling diagram</td><td>0000-101/102-POI-A-021</td><td>3</td></tr> <tr> <td>7.</td><td>Instrument Source Connection details</td><td>0000-999-POI-A-035</td><td>14</td></tr> <tr> <td>8.</td><td>Typical GA of Local Instrument Enclosure, purging scheme, DP transmitter</td><td>0000-999-POI-A-036</td><td>1</td></tr> <tr> <td>9.</td><td>Interfacing of actuators</td><td>0000-999-POI-A-063</td><td>1</td></tr> <tr> <td>10.</td><td>Interfacing of field instruments/Electrical interface/PLC Interface</td><td>0000-999-POI-A-065</td><td>15</td></tr> </tbody> </table> (C) ELECTRICAL <table border="1"> <tbody> <tr> <td>1.</td><td>Electrical single line diagram for FGD Package</td><td>0011-109(2)-POE-J-001/A</td><td></td></tr> </tbody> </table> Note : All the above drawings included in Part-E are indicative of Employer's requirements to enable the Bidder to make a suitable offer. All variations/alternations shall be clearly brought out in the technical deviation schedule with implications, if any. Such variations may be acceptable, after assessment of its implication and shall be subjected to the Employer's approval. However, the flexibility of operation and maintenance desired by the schemes and layouts shall be binding. Electrical drawings (except Electrical single line diagram) are attached with respective Electrical Chapters in Part B, Section VI.			Sl. No.	Drawings Title	Drawings No.	No. of Sheets	1.	Standard configuration diagram for control system	0000-151-POI-A-013	1	2.	G.A. of Junction Box	0000-999-POI-A-017	1	3.	Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply	0000-999-POI-A-019A	2	4.	Scheme of 24V DC Power supply system	0000-999-POI-A-019B	1	5.	Scheme for Uninterruptible Power Supply System	0000-999-POI-A-019C	1	6.	Instrumentation/control/power supply cabling diagram	0000-101/102-POI-A-021	3	7.	Instrument Source Connection details	0000-999-POI-A-035	14	8.	Typical GA of Local Instrument Enclosure, purging scheme, DP transmitter	0000-999-POI-A-036	1	9.	Interfacing of actuators	0000-999-POI-A-063	1	10.	Interfacing of field instruments/Electrical interface/PLC Interface	0000-999-POI-A-065	15	1.	Electrical single line diagram for FGD Package	0011-109(2)-POE-J-001/A	
Sl. No.	Drawings Title	Drawings No.	No. of Sheets																																																
1.	Standard configuration diagram for control system	0000-151-POI-A-013	1																																																
2.	G.A. of Junction Box	0000-999-POI-A-017	1																																																
3.	Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply	0000-999-POI-A-019A	2																																																
4.	Scheme of 24V DC Power supply system	0000-999-POI-A-019B	1																																																
5.	Scheme for Uninterruptible Power Supply System	0000-999-POI-A-019C	1																																																
6.	Instrumentation/control/power supply cabling diagram	0000-101/102-POI-A-021	3																																																
7.	Instrument Source Connection details	0000-999-POI-A-035	14																																																
8.	Typical GA of Local Instrument Enclosure, purging scheme, DP transmitter	0000-999-POI-A-036	1																																																
9.	Interfacing of actuators	0000-999-POI-A-063	1																																																
10.	Interfacing of field instruments/Electrical interface/PLC Interface	0000-999-POI-A-065	15																																																
1.	Electrical single line diagram for FGD Package	0011-109(2)-POE-J-001/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-I INTENT OF SPECIFICATION	PAGE 6 OF 21																																																

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

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

CLAUSE NO.	INTENT OF SPECIFICATION				एनटीपीसी NTPC
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	
				not less than 90% thru 325 mesh	
				Station size of 500 MW & Below - Capacity 10 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh	
(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	Unit size of 500 MW & Above - Flow 50 m3/hr (min.) with head 30 Meters of Liquid Column (min.)	
				Unit size of 250 MW & Below - Flow 25 m3/hr (min.) with head 30 Meters of Liquid Column (min.)	
(f)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application	
(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant or in any other process application	Station size of 3000 MW-Capacity 65 T/hr (min.)	
				Station size of 1980 MW-2000 MW-Capacity 50 T/hr (min.)	
				Station Size of 1500 MW-Capacity 35 T/hr (min.)	
				Station size of 500 MW & Below-Capacity 17 T/hr (min.)	
The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01(a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment. The provenness criteria for equipment (Slurry Recirculation Pumps) stipulated at Sl. No. 4.01.01(b) above shall also be considered acceptable provided the rating parameters (i.e., flow and head) is covered within the operating regime of the					
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 9 OF 21

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

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

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

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC							
	cutting in hard rock, piling, RCC in underground storage hopper and underground tunnels) for which it is being engaged. Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them. Design agency for Civil & Steel Structural Works:								
4.02.05	Bidder or its agency (ies) should have carried out the design and detailed engineering of following works: (i) Civil & Structural works associated with at least one bulk material handling plant for * or higher capacity coal based/Lignite based power plant (applicable for project having ** MW unit rating). (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations.								
4.02.06	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 4.02.05. The design agency (ies) proposed by the Bidder shall be subject to Employer's approval. Note:- For value of * and ** refer table below: <table><tr><td>*</td><td>**</td></tr><tr><td>195 MW</td><td>195 MW/ 250 MW/ 500 MW</td></tr><tr><td>500 MW</td><td>660 MW</td></tr></table>	*	**	195 MW	195 MW/ 250 MW/ 500 MW	500 MW	660 MW		
*	**								
195 MW	195 MW/ 250 MW/ 500 MW								
500 MW	660 MW								
4.03.00	PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS								
4.03.01	HT MOTORS								
4.03.01.01	BOOSTER FAN MOTOR Bidder/Sub Vendor should have manufactured and supplied motor of 4MW or above rating, which should have been in successful operation in at least one (1) plant for at least two (2) years.								
4.03.02	LT SWITCHGEAR								
4.03.02.01	ROUTE 1								
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION						
			PAGE 13 OF 21						

CLAUSE NO.	INTENT OF SPECIFICATION 		
4.03.02.01	(i) Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years.		
	And		
4.03.02.01	(ii) Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) numbers of Air Circuit Breakers having fault rating of at least 45kA rms BREAKING, 105kA peak MAKING and 45kA withstand for one (1) second, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years.		
4.03.02.02	ROUTE 2		
4.03.02.02	(i) Bidder/Sub-vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years.		
	And		
4.03.02.02	(ii) Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) numbers of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years.		
	And		
4.03.02.02	(iii) Bidder/Sub-vendor shall be considered qualified provided its Associate or Collaborator or Technology Provider or Licensor meets the requirement stipulated in Route 1 for sourcing of Air Circuit Breakers. The Associate or Collaborator or Technology Provider or Licensor shall provide a letter of technical support for successful performance of the Air Circuit Breakers, as per the format, given in the bidding document. This letter of technical support should be submitted at the time of placement of order on the Sub-Vendor.		
	And		
4.03.02.02	(iv) Bidder/ Sub Vendor should have established manufacturing facility for draw out type Air Circuit Breaker Panels and draw out type Motor Control Centre Panels in India. Further, all the panels for this project shall be manufactured and supplied from the Indian manufacturing facility.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION PAGE 14 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC	
Note:	1. Each Single Front Panel shall be counted as one (1) Panel, Double Front Panel as one (1) Panel and Air Circuit Breaker Panel as one (1) Panel. 2. The provenness criteria shall be applicable for all draw out type and fixed type switchboards except Lighting DBs and Welding DBs.		
4.03.03	33kV / 11 KV / 6.6 KV / 3.3 KV SWITCHGEARS		
4.03.03.01	Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 6.6kV or above Switchgear panels with fault rating of at least 40kA for one (1) second and 100kA peak, which should have been in successful operation for at least two (2) years.		
4.03.03.02	Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 6.6kV or above panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for at least two (2) years.		
4.03.04	NUMERICAL RELAYS		
4.03.04.01	Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor Protections. These relays should have been in successful operation for at least two (2) years.		
4.03.05	FGD TIE TRANSFORMER (100 MVA 220/34.5 kV)		
4.03.05.01	Bidder/Sub-vendor should have designed, manufactured and supplied at least two (2) numbers (one each at two different installations) of 220 kV or above class transformers of at least 100MVA capacity which should have been in successful operation for at least two (2) years.		
	And		
4.03.05.02	90 MVA, 132 KV or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested.		
4.03.06	AUXILIARY OIL FILLED TRANSFORMERS		
	(Transformers not covered under Clause 4.03.05)		
4.03.06.01	Bidder/ Sub-Vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled transformers which should have been in successful operation for at least two (2) years.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION PAGE 15 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
	And 4.03.06.02 Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test). And 4.03.06.03 16 MVA, 11 KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested. <u>Note (applicable for Cl. No. 4.03.05 & 4.03.06):</u> i) Two different installations mean two different project sites or two different contracts. ii) Equipment designed by the Bidder/Sub-vendor by itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.			
4.03.07	SWITCHYARD 220KV EQUIPMENT I. 220 kV CIRCUIT BREAKERS 220kV Circuit Breakers being offered should be from Manufacturer who has manufactured and supplied atleast five(5) nos. of three phase circuit breakers suitable for Air Insulated Substation/ Switchyard of 220 kV or above class which should have been in successful operation for at least two(2) years. II. 220 kV INSTRUMENT TRANSFORMERS (Current Transformers / Voltage Transformers as Applicable) 220 kV Instrument Transformers being offered should be from Manufacturer who has manufactured and supplied atleast fifteen (15) nos. of single phase Instrument Transformers suitable for Air Insulated Substation/ Switchyard of 220 kV or above class which should have been in successful operation for atleast two (2) years. III. 220 kV DISCONNECTORS 220kV Disconnectors being offered should be from Manufacturer who have manufactured and supplied atleast five (5) nos. of three phase Disconnectors suitable for Air Insulated Substation/Switchyard of 220kV or above class which should have been in successful operation for atleast two (2) years. IV. 220 kV SURGE ARRESTORS 220kV Surge Arrestors being offered should be from Manufacturer who has manufactured and supplied atleast fifteen (15) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 220kV or above class which should have been in successful operation for atleast two (2) years.			
4.03.08	CONTROL AND PROTECTION			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 16 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION			
4.04.00	The Bay Protection and control Units offered should be from Manufacturer(s) who have manufactured and supplied the offered type of devices for respective equipment, which should have been in successful operation in a 220kV class or above Substation/switchyard for at least two (2) years. PROVENNESS CRITERIA FOR CONTROL AND INSTRUMENTATION (C&I) EQUIPMENTS / SYSTEMS The Bidder or its proposed sub vendor(s) should meet the provenness requirements as stipulated under clause 4.04.01, 4.04.02 and 4.04.03. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on the date of consideration for approval but not later than six months after award date of LOT-2 FGD package unless otherwise specified in the respective clauses.			
4.04.01	The Distributed Digital Control, Monitoring and Information System (DDCMIS) supplier of this package should be Indian Company registered in India as per Companies Act and should have engineered, supplied, and commissioned/ got commissioned BOP DDCMIS/DCS system in at least one (1) unit of rating 200MW or above in a power station.			
4.04.02	The Control system offered for this package shall be same or of same series which is operating successfully for a period of not less than one (1) year in at least one (1) unit of rating 200MW or above in a power station for BOP application.			
4.04.03	The other C&I systems offered for this package shall meet the following: a) UPS system offered for this package shall be same or of same series and type as that of 105 KVA or above capacity UPS which should have been in successful operation for a period of not less than one (1) year in a power station. b) 24 V DC modular charger offered for this package shall be same or of same series and type as that of 500A or above capacity 24 V DC modular charger which should have been in successful operation for a period of not less than one(1) year in any industry or telecommunication application. c) CEMS and Vibration Monitoring system offered for this package shall be same or of same series which should have been in successful operation for a period of not less than one(1) year in at least one(1) unit of rating 200MW or above in a power station.			
(A)	Notes:- Control system for BOP application referred in Para 4.04.01 and 4.04.02 means following : (i) Control system for BOP shall include Modulating control for Steam Generator (SG), Modulating control for feed water / Condensate Cycle, Binary Control of the			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 17 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION			
	auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units.			
4.05.00	RO BASED DESALINATION PLANT			
4.05.01	Route-1			
4.05.01.01	Bidder/ Bidder's sub vendor should have designed, supplied, erected and commissioned/supervised commissioning of one (1) number RO based Desalination Plant of minimum capacity (permeate flow) of 150 Cum/hr OR two (2) numbers RO based Desalination Plants in separate contracts each of minimum capacity (permeate flow) of 75 Cum/hr OR three (3) numbers RO based Desalination Plants in separate contracts each of minimum capacity (permeate flow) of 50 Cum/hr. The above desalination plant(s) shall have Reverse Osmosis Unit(s) having inlet feed as Sea Water and capable of producing permeate water quality with TDS not more than 500 ppm. The plant(s) should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.05.02	Route-2			
4.05.02.01	Bidder/ Bidder's sub vendor who do not meet, the requirement stipulated at 4.05.01.01 above may also participate provided they have designed, supplied, erected and commissioned/supervised commissioning of at least one (1) number water/waste water treatment plant having capacity of not less than 1000 cum/hr., comprising of clarifiers/tube settlers/thickeners or a combination thereof including civil works and in successful operation for at least one (1) year prior to the date of Techno-Commercial bid opening and collaborates/associates with a firm who fully meets the requirements stipulated at 4.05.01.01 above.			
4.05.02.02	In such a case, the Bidder/its sub-vendor shall be required to furnish a letter of technical support from Collaborator / Associate for successful performance of Condensate Polishing Plant, as per the format enclosed in the bidding document. This letter of technical support should be submitted to NTPC prior to the placement of order on approved sub-vendor.			
4.06.00	WATER PRE-TREATMENT PLANT			
	The Bidder/its sub-vendor should have designed, supplied, erected and commissioned at least one (1) number water/waste water treatment plant, each with a capacity of not less than 1000 Cu.m/hr, comprising of clarifiers/tube settlers/thickeners or a combination thereof including civil works. The plant should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 18 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC	
4.07.00	Provenness criteria for critical equipment, auxiliaries, systems and bought out items for RO based desalination plant/ PT plant		
4.07.01	Lamela Clarifiers/Tube settlers The design of the Lamella Clarifiers / Tube Settlers offered for this package shall be obtained from a firm who have designed, supplied and commissioned atleast two (2) numbers Lamella Clarifiers/ Tube Settlers each of minimum capacity 400 cu.m/hr. with effluent turbidity not exceeding 20 NTU/ppm/JTU. The Lamella Clarifiers/ Tube Settlers should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.		
4.07.02	Filters The design of filters offered for this package shall be obtained from a firm who have designed, supplied and commissioned atleast one (1) number filter as offered each of minimum capacity 200 cum/hr. with effluent turbidity not exceeding 5 NTU/ppm/JTU. The filter should be should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.		
4.07.03	Ultrafiltration System Bidder/ bidder's sub vendor shall source the Ultra Filtration system including membrane upstream to Sea Water Reverse Osmosis (SWRO) plant from such suppliers who has supplied in a single SWRO plant one (1) number of UF system as offered of capacity not less than 435 cum/hr having each stream/skid/train of capacity not less than 145 cum/hr and such UF system including membrane should have been in successful operation for at least one (1) year prior to the date of Techno-Commercial bid opening. Ultra Filtration (UF) system mentioned above shall mean the UF modules consisting of membranes, module body, supports of module, frame, feed and filtrate headers as minimum. Ultra Filtration membrane shall be sourced from such manufacturer who has supplied membrane to the UF system and such membrane should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.		
4.07.04	HP Feed Pumps for SWRO units HP Feed pumps for SWRO units to be used for this project shall be supplied from such manufacturers who have manufactured and supplied one (1) number of pump of minimum 500 cum/hr. capacity for sea water RO plant and such pump should		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION
			PAGE 19 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
4.07.05 4.07.06 4.07.07 4.07.08	have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. Energy Recovery System for SWRO The energy recovery system (turbo charger or pressure exchanger as the case may be) to be used for this project shall be supplied from such manufacturers who have manufactured and supplied one (1) set of complete Energy recovery system for sea water RO of minimum stream capacity 150 cum/hr. (permeate flow) and such system should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.07.04 and 4.07.05 above in India can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.07.04 and 4.07.05 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/his sub-vendor(s) must create/have created manufacturing facilities at his works as per collaborator's/ licensor's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its Holding company/Subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/Subsidiary or upto the end of defect liability period of the contract, whichever is later. Before taking up the manufacturing of such equipment(s) as per clause 4.07.04, 4.07.05, 4.07.06 above, the Bidder/its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator/licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator/licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments. Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.			
	LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		
		SUB-SECTION-I INTENT OF SPECIFICATION		
		PAGE 20 OF 21		

CLAUSE NO.	INTENT OF SPECIFICATION			
4.07.09	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.			
4.08.00	Agency for Wet Stack Flow Model Study Wet Stack Flow Model Study shall be carried out by an agency which has successfully performed at least two (2) flow model studies, in separate coal fired power plants, of wet stack installed after wet limestone based FGD Absorber (without reheating of cleaned flue gas), and based on the studies developed at least two (2) wet stack liquid collection systems which are in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.09.00	Balance equipments/ systems The Bidder at his option can source the balance of plant equipment/systems not covered in clause 4.01.00, 4.02.00, 4.03.00, 4.04.00, 4.05.00, 4.06.00, 4.07.00 & 4.08.00 above. However for such balance of plant equipment/systems, the Employer reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers.			
4.10.00	Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/his collaborators/ licensor/ his sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.			
4.11.00	To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 21 OF 21

SUB-SECTION-II

PROJECT INFORMATION

(CHAPTERS FOR EACH PROJECT ENCLOSED SEPARATELY)

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

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(2)-9**

SUB-SECTION-III

SCOPE OF SUPPLY & SERVICES

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	SCOPE OF SUPPLY AND SERVICES			
	The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, engineering, manufacture, inspection and testing at supplier's works, packing, forwarding to site, unloading, pre- assembly, assembly, erection, supervision, pre-commissioning, testing and commissioning and performance testing of the equipment/system and works indicated in this Sub section of the technical specification. Any item or works though not specifically mentioned in this specification but needed to complete the equipment & systems to meet the intent of the Specification shall also be furnished, unless specifically mentioned under "Exclusion" in Sub-Section-IV of Part-A, Section-VI of the Technical Specifications.			
1.01.00	The scope of supply & services is detailed out in the following Sub-Sections.			
	Sub-Section			
	III A	-	Mechanical equipment and associated systems	
	III B	-	Electrical systems	
	III C	-	C&I systems	
	III D	-	Civil works	
1.02.00	Scope of supply of the Contractor includes mandatory spares, start-up and commissioning spares and consumables. The general requirements in respect of various types of spares is given in Sub-Section-VII, Part-A of Technical Specification.			
1.03.00	Tests			
	The scope of the Bidder includes all shop tests, type tests, site tests, routine tests, etc., fulfillment of complete quality assurance & inspection requirements and related activities for all the equipment & systems covered under the scope of work of Bidder as per the stipulations of Technical Specifications.			
1.04.00	Paints / Painting			
1.04.01	The Contractor's scope of work includes supply of paints and painting of all equipments and structures as per the Employer's standard color coding scheme which shall be furnished to the Contractor during detail engineering stage. The painting of various components shall comply with the requirements stipulated in different part of this specification. However, for components where no specific requirement is stipulated, the painting conforming to the requirements stipulated below shall be provided.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9		PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES
PAGE 1 OF 6				

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	(i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard. (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. Painting specification for coastal projects Simhadri Stage-I & II (2x500 MW + 2x500 MW) & Vallur (3x500 MW) shall be same as that given in clause 2.18.00, LP piping Sub-section, Part-B, Section-VI.			
1.04.02	The flue gas swept surface of Absorber inlet ducting (excluding wet dry interface section) shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard and applied with of 50 microns of ethyl silicate zinc primer (suitable upto minimum 400 degree Celsius).			
1.04.03	For flue gas ducts, gates and dampers, surface preparation shall be SP3/SP4 and Heat Resistant Aluminium Paint to IS:13183 Gr-II with two coats of minimum DFT of 20 microns each shall be applied.			
1.05.00	Pre-commissioning and Commissioning Activities			
1.05.01	Contractor's Scope shall include all pre-commissioning and commissioning activities, required for successful performance of all equipments and systems under this package. Contractor's scope shall also include supply of all materials and services including the following for successful conductance of pre-commissioning and commissioning activities:			
1.05.02	Complete pre-commissioning work including tests of facilities and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.			
1.05.03	Commissioning and initial operation of the facilities.			
1.05.04	Supply of all consumables as may be required for above pre-commissioning/ commissioning activities			
1.05.05	Supply of all temporary equipment such as piping including supports, valves, blowers and all necessary instrumentation for successful conductance of pre-commissioning and commissioning activities. All temporary equipments, blowers, valves etc. brought to sites, by the Contractor for pre-commissioning/commissioning purpose shall be in good working condition to ensure its safe and reliable operation			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES	PAGE 2 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC	
	at site. All such temporary equipments/components shall be brought to site at least three (3) months prior to commencement of relevant pre-commissioning/ commissioning activities. On receipt of the temporary equipments/components at site, the same shall be inspected by the Employer to ensure its safe and reliable operation and if in the opinion of the Employer the temporary equipments/ components are not in satisfactory conditions to ensure it's safe and reliable operation the same shall be immediately replaced by the Contractor.		
1.05.06	The temporary equipments specifically brought by the Contractor solely for the pre-commissioning and commissioning work shall on completion of these activities, remain the property of the Contractor.		
1.05.07	The selection of material of all the temporary equipments/ instruments shall be compatible with the service conditions expected during pre-commissioning/ commissioning activities.		
1.05.08	All temporary equipments and instruments shall be clearly listed out in the bid.		
1.05.09	Supply of all labour, skilled/ semi skilled supervisors, engineers and any other manpower.		
1.05.10	The scope of Contractor shall also include necessary approach & platforms for all the instruments required during commissioning and testing. These approach platforms shall be provided to meet all required safety norms and these shall be permanent nature.		
1.06.00	First Fill of Consumables, Oils & Lubricants All the first fill and one year's topping requirements of consumable such as grease, oil, lubricants servo fluids etc. which will be required to put the equipments covered under the scope of specifications, into successful commissioning/initial operation and to establish completion to facilities shall be furnished by the Contractor, unless specifically excluded under the Exclusions in these specifications and documents. Limestone shall be supplied by the Employer.		
1.07.00	Guarantee Tests The Guarantee tests for various equipment and systems shall be carried out as specified under Sub-Section-VI, Part-A of Technical Specification. All special equipment, tools and tackles, instruments, measuring devices required for the successful conductance of Guarantee Tests shall be provided by the Contractor, free of cost. All costs associated with the tests shall be included in bid price.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES
PAGE 3 OF 6			

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.08.00	Spare Parts The Contractor's scope of supply includes all the necessary commissioning spares, mandatory spares as described Sub-Section-VII / Part-A in the schedule of spare parts. The Employer reserves the right to finalize the exact quantities of the spare parts and effect price adjustment on the basis of the rates quoted by the Contractor. The Spare ordered by Employer shall be delivered at the site as per agreed delivery schedule.			
1.08.01	Mandatory Spares The Bidder shall indicate the prices for each & every item (except for items not applicable to the Bidder's design) in the 'Schedule of mandatory spares' whether or not he considers it necessary for the Employer to have such spares. If the Bidder fails to comply with the above or fails to quote the price of any spares items, the cost of such spars shall be deemed to be included in the contract price. The Bidder shall furnish the population per unit of each item. Wherever sets are mentioned, the Bidder has to give the item details & prices of each item			
1.08.02	Recommended Spares In addition to the spares mentioned above, the Bidder shall also indicate in the 'Schedule of recommended list of spare parts', his recommended list of spare with unit prices, for three years of normal operation of the plant. The Employer reserves the right to buy any or all of the recommended spare parts. The Bidder shall also indicate the service expectancy period for the spare parts under normal operating conditions before the replacement is necessary. In case some of the spares parts become not applicable due to change in design/engineering agreed by the Employer, the Employer reserves the right to procure some other spares whose prices are already available in the initial offer in lieu of such not applicable spares subject to the condition that the total amount of the initial order remains the same.			
1.08.03	Commissioning Spares It will be the responsibility of the Contractor to assess and furnish a list of all commissioning spars required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Contractor within 8 months from the date of LOA, separately for each equipment and shall be reviewed by NTPC and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the Initial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Contractor of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Contractor as a part of the respective equipment package at no extra cost to the Employer.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES	PAGE 4 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.08.04	Packing & Preservation Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplier shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Employer to procure these items from indigenous sources.			
1.09.00	Special Tools & Tackles and Test/Measuring Equipments One set of all special tools and tackles including testing, calibrating and measuring instruments required for erection, assembly, disassembly and maintenance of all equipments/systems covered under the scope of the Contractor shall be supplied by the Contractor. These shall not be used for erection/commissioning purposes and shall be in an unused and new condition, when they are handed over to the Employer. A list of such special tools and tackles shall be submitted along with the offer.			
1.10.00	The scope of the Contractor includes complete design and engineering, technical co-ordination (including participation and arranging technical co-ordination meetings), finalization of drawings/documents, submission of engineering drawing/documents and processing of their approvals by the Employer as detailed in Part-C, Section-VI and other relevant clauses given elsewhere in the technical specification. Further, the scope shall also include submission, in proper shape & format, of all types of manuals, handbooks & documents in requisite numbers to the Employer at different phases of the project as per the requirement of Employer.			
1.10.01	Bidder shall furnish all relevant data required by the Employer, at interface points within 45 days of notification of award.			
1.11.00	Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. and will be in owner's scope. However, site clearance like removal of bushes, vegetation etc. is in bidder's scope. Existing Pipe /cable trestles, conveyors etc. passing through the proposed FGD area shall be retained, and FGD layout shall be prepared accordingly.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES	PAGE 5 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.12.00	The bidder shall take all necessary precautions to protect the entire existing equipments, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason what so ever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. If during the execution of works it is found that there is interference with the existing facilities / structures, the bidder shall revise his design / detailed drawings to clear the interference and shall provide all necessary measures for the safety of existing structures. In case the details shown in tender drawings are found to be different from actual details at site, bidder shall revise his design/ detailed drawings to suit the constraints at site. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for safety measures provided. If at any stage of work, any dismantling or modification or relocation of hindrance and evident facilities (over ground and underground) is required to be done to complete the work in bidder's scope and which has been agreed by the Employer, the same shall be done by the bidder at no extra cost or time implication to the Employer. All such changes will be as per drawings and work plan approved by the employer. However, any dismantling / relocation of non-evident underground facilities, if required and agreed to be dismantled/relocated by the Engineer in-charge, shall be done by the employer.			
	Execution shall be taken up in parallel in blocks of two units where FGDs are to be installed at more than two units in a project. Accordingly, executing agency shall work in parallel in each block of maximum two units.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(2)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES	PAGE 6 OF 6

SUB-SECTION-III-A

MECHANICAL EQUIPMENTS & SYSTEMS

SUB-SECTION-III-A1

FLUE GAS DESULPHURISATION SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
	SCOPE OF SUPPLY	
1.00.00	The contractor's scope of supply shall include engineering, design, manufacture, supply, erection, commissioning and testing of complete mechanical, electrical, C&I and associated civil and structural works for Flue Gas Desulphurization system and its auxiliaries for Lot 2 Projects [(1) TSTPS-I&II (2x500 + 4x500 MW), (2) Simhadri-I&II (2x500 MW + 2x500 MW), (3) Sipat-I (3x660 MW), (4) Vallur (3x500 MW), (5) Bhilai (2x250 MW), (6) Muzaffarpur TPS (2x195 MW) & (7) Rourkela (1x250 MW)], as detailed in this specification. Steam generator (in Employer's scope) shall be Sub-critical/super-critical, balance draft, dry bottom, pulverised coal fired type. The characteristics of the coal, ash and other relevant design data is given in Part-A, Sub section-V of this specification. The FGD system shall be necessarily based on Wet Lime Stone FGD technology and is intended to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to the limits specified elsewhere in the technical specification.	
1.01.00	Complete Electrical & Control & Instrumentation system as required for the FGD system shall be included in the scope of supply. All electrical drives and actuators required for the equipment/valves/dampers shall be in the contractor's scope. Complete Civil works, structures, foundation required for all the equipment etc. is included in the contractor's scope of work. The contractor shall also include all supporting and structural works, like pipe trestles, platforms, staircases in their scope of work.	
1.02.00	The scope of supply identified for FGD system here are minimum requirements and unless specifically excluded from the contractor's scope in sub-section-IV (Terminal Points and Exclusions), any equipment/system not included in this specification but integral to the system offered by the contractor to meet the intent of this specification, shall also be included in the scope of the contractor.	
1.03.00	The FGD system shall have an independent absorber for each unit, common limestone milling systems and common gypsum dewatering system for each Lot 2 Project. The contractor shall also supply an auxiliary absorbent tank, common for all the units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, common limestone grinding system and gypsum dewatering system.	
1.04.00	The scope of the contractor for FGD system shall include all items as shown in Tender drawings. All ducting, dampers, expansion joints, pumps, valves, supports, structures etc. as required for completeness of system of absorbers, common limestone grinding system & common gypsum dewatering system shall also be in the scope of the contractor for each Lot 2 Project.	
2.00.00	SYSTEM DESCRIPTION	
2.01.00	The FGD system shall be based on Wet Limestone Forced Oxidation process. Each unit shall be provided with an independent absorber.	
2.02.00	Gas from terminal point on ID fan discharge duct shall be taken directly to the absorber through Booster Fans. In the absorber, SO ₂ in flue gas shall be removed by a spray of recirculating slurry, pumped by slurry recirculation pumps. Alternatively, the gas shall be bubbled through the absorber slurry to remove the SO ₂ from flue gas. Only proven system supplied earlier by the FGD vendor shall be supplied by the contractor. For Rourkela (1x250 MW) project, booster fan shall be provided only if the existing ID fan is not sufficient to take care of the pressure losses	
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-III-A1 FGD
		Page 1 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	in the FGD system and its associated ducting.			
2.03.00	Compressed oxidation air shall be blown through the slurry in the oxidation tank, to oxidize the Calcium sulfite to gypsum. The oxidation system may be either grid sparge type or lance jet type or Jet Air Sprager or any other proven system as per the practice of the FGD vendor.			
2.04.00	Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper is included in the scope of the Contractor. For Rourkela (1x250 MW) project, Wet Chimney, FGD inlet gate, FGD outlet gate and bypass damper is in the scope of Employer.			
2.05.00	Limestone to the absorbers of the units shall be supplied by a wet limestone grinding system, common for the units. Limestone shall be fed to the Limestone day silos which in turn will feed the Limestone to wet ball mill through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (2 no) limestone slurry storage tanks to be provided by the contractor, from where the slurry shall be pumped to the individual absorbers by dedicated limestone slurry pumps.			
2.06.00	The gypsum from the absorber(s) shall be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of two streams (2x100%) of primary and secondary hydrocyclone and vacuum belt filters for gypsum dewatering. The water removed from the absorber shall be recycled to the absorbers. The waste water from the system shall be collected and neutralized using lime and neutralized effluent shall be pumped at required pressure to waste water terminal point as indicated in Sub-section IV, Part A of the Technical Specification. Contractor shall provide complete automated waste water neutralization system along with automated lime feeding and dosing system to ensure required pH of waste water is ensured before being discharged at the terminal point. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor. The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor to be provided by the Contractor.			
2.07.00	A common auxiliary absorbent tank shall be provided for storage of absorber slurry of one absorber along with slurry pumps for pumping the slurry back to any of the absorber.			
3.00.00	LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM (COMMON FOR ALL UNITS) FOR EACH LOT 2 PROJECT			
3.01.00	The contractors scope shall include a common limestone grinding system for all the units and shall comprise of:			
3.01.01	2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the requirements of all the units. The storage silo shall be complete with supporting steel structure, platforms, staircase, air canons, power operated gates, gravimetric feeders, level switches, air relief devices, etc.			
3.01.02	2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of all the units at Design point.			
3.01.03	Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for of all the units at Design point, complete with all accessories and Agitator(s).			
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-III-A1 FGD	Page 2 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
3.01.04	2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank. Each pump catering to slurry requirement of each unit's absorber.			
3.01.05	Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves.			
3.01.06	Each mill shall be fed from an independent Limestone bunker. Each mill shall be complete with the following items, as a minimum requirement: i. A bunker outlet gate ii. A gravimetric limestone feeder along with its drive and all other auxiliaries iii. 1 no. separator tank with agitator(s). iv. 2x100% Mill circuit pump. v. 1 set of hydro-cyclone vi. A peripheral/central drive system with motor, speed reducer gearbox and other auxiliaries. vii. An auxiliary motor for inching operation with speed reducer. viii. Complete lubricating system with appropriate lubricating medium storage facility (i.e. 1 no. lube oil tank for storage of lube oil and/or 1 no. grease storage drum as required). ix. Lube oil pumps, coolers, duplex oil filters, connecting piping and necessary load & remote indicating instruments. Each lube oil pump and cooler shall have a 100% identical stand-by.			
3.01.07	All connecting pipes / chutes along with necessary valves between various systems of the mill and from hydro-cyclone to common slurry storage tanks shall also be in the scope of the contractor. Necessary pipes, pipe supports, trestles etc. as required for the routing of the pipes shall be under the contractor's scope. Any item not included above but necessary for safe and reliable operation of the milling system proposed by the contractor shall also be in the contractors' scope.			
3.01.08	The complete Limestone Grinding System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase & one (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for easy access & movement of man/materials. etc. The building shall be sufficiently ventilated.			
4.00.00	ABSORBER SYSTEM			
4.01.00	An independent Limestone Forced Oxidation (LSFO) type absorber system shall be provided for each unit. Each absorber system shall be complete with :			
4.01.01	Absorber tower complete with re-circulating slurry spray header(s) and nozzles, three stage mist eliminators, wash water nozzles, oxidation tank integral to tower, oxidation headers and nozzles, and agitators and all internal systems integral to the working of the absorber.			
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-III-A1 FGD	Page 3 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
4.01.02	2x100% re-circulating slurry pump for each level of spray. Alternately, the contractor may offer a spare level of spray with each spray level served by an independent 100% pump. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided. (In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No re-circulating pump and spray header and nozzles shall be required in such case.)			
4.01.03	Complete Ducting System from ID fan common outlet duct to absorber tower & from absorber outlet to wet stack chimney. For Rourkela (1x250 MW) project, the ducting scope shall be as per terminal points shown in Drawing attached with Tender Drawing at Part – E.			
4.01.04	2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / positive displacement (Helical lobe) type with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank.			
4.01.05	1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition.			
4.01.06	All connecting piping and valves required by the system.			
4.01.07	2x100% gypsum bleed pumps.			
4.01.08	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves.			
4.01.09	Routing of the duct/piping system complete with supports, structures, trestles, absorber platforms, as required shall be in the contractor's scope of supply.			
4.01.10	Passenger cum Goods elevator of minimum capacity of 1000 kgs for each Absorber of height of more than 20 m.			
4.01.11	All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a shed provided with roof sheeting to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line, however, if it is not possible due to layout constraints, in such case, arrangement for handling & maintenance should be properly & optimally designed. The shed must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.			
5.00.00	GYPSUM DEWATERING SYSTEM			
5.01.00	The employer envisages a common gypsum dewatering system for all the units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two sets of dewatering equipments.			
5.02.00	Each set (suitable for handling /dewatering of all the unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement: i. One set of primary hydro-cyclones			
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-III-A1 FGD	Page 4 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	ii. One vacuum belt filter iii. One no. vacuum receiver iv. One no. vacuum pump v. One set of secondary hydro-cyclones vi. Complete piping and valves for the system along with wash water line. 5.03.00 This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating simultaneously at Design Point, with any range of limestone specified. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. 5.04.00 The filtrate water from belt filter dewatering and wash water from washing system and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. The contractor shall include the necessary piping and valves in their scope. 5.05.00 The gypsum slurry from each Absorber shall be fed to a common Primary hydro cyclone feed tank (sized for minimum 1 hr storage capacity) from where it will be fed to each primary set of hydro-cyclone through 2x100% Primary hydro cyclone pumps. The overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydro cyclone feed tank. 2x100% Secondary hydro cyclone pumps shall be provided to feed 2x100% secondary hydro-cyclones. The underflow from the primary hydro-cyclone shall be fed to the 2X100% vacuum belt filter system. 5.06.00 The under flow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water neutralization system to be provided by the Contractor. The waste water system shall be complete with lime feeding & storage system, neutralization tank, waste water tank, 2x100% waste water pumps along with complete piping, instrumentation, valves, piping support etc. to discharge waste water at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. All the piping with supports, trestles as required shall be in the contractors' scope. The contractor shall also include any other item not included above but necessary to make the system complete. 5.07.00 The complete Gypsum Dewatering System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways for easy access & movement of man/materials etc. The building shall be sufficiently ventilated. 6.00.00 AUXILIARY ABSORBENT TANK 6.01.00 The Contractor shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. 6.02.00 The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). All agitators, piping, valves, fittings and			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-III-A1 FGD	Page 5 of 9	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
7.00.00 7.01.00 7.01.01 7.02.00 7.03.00 7.04.00 7.05.00 7.06.00 7.07.00 7.08.00 8.00.00 8.01.00 8.02.00	other structures required for the system shall be included in the scope of the contractor. PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME Two (2) Process water Storage tanks (each tank catering to the requirements of all the units) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of all the units) along with all necessary piping, valves, control & instrumentation to feed the tank from terminal point. Process water Storage level is automatically controlled at operating level by controlling the water flow from the Cooling Tower Blow down System from terminal point. The two tanks shall be interconnected with an isolation valve. 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (for example total 8 nos. of pumps for 4x500 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (for example total 8 nos. of pumps for 4x500 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. Two (2) clarified water Storage tanks (each tank catering to the clarified water requirement for one vacuum Belt Filter) along with two numbers of 2x100 % clarified Booster water pumps, if required, from terminal point. 2x100% cake washing Pumps for each Vacuum Belt Filter. 2x100% cloth washing Pumps for each Vacuum Belt Filter. Any other pump or storage system not specified but required to meet the system requirement shall be provided by the contractor with the approval of the Employer. All drains & overflow lines from the tanks shall be terminated to the nearest trench/drain. All the storage tanks shall be lined with replacable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness from inside. SUMP & SUMP PUMPS The contractor shall provide sumps of adequate capacity in each of the following area: A. Each Absorber Area B. Limestone Grinding system C. Gypsum dewatering system Waste water which might be generated during flushing and cleaning procedures of the equipment shall be collected in the sump and shall possibly be reused in the wet absorber. The contractor shall provide agitators and sump pumps of required capacity in each of this area along with necessary pipes, isolation / control valves etc for pumping			
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-III-A1 FGD	Page 6 of 9	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	back the water in the sump into the respective system. The Interior surface of the Sumps shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness.			
9.00.00	Elevator			
9.01.00	One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for each Absorber (to be provided in case height of absorber is higher than 20m) and One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs in Limestone Grinding System Building shall be provided for easy access & movement of man/materials.			
9.02.00	The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include provision of fireman's switch.			
9.03.00	One (1) nos. adequately sized, Air conditioners each having minimum cooling capacity of 2.5 Ton shall be provided for each elevator machine room to make it dust proof.			
9.04.00	Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection.			
9.05.00	To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby.			
10.00.00	Thermal Insulation, Lagging, Cladding & Refractories Thermal Insulation alongwith aluminum cladding, lagging, reinforcement wiremesh, cleats and supports, shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. The insulation thickness shall be designed based on criteria specified in Part-B, Section-VI.			
11.00.00	Buildings			
11.01.00	Contractor shall provide buildings for Limestone Grinding System, Compressors, Gypsum Dewatering System & FGD control room. Slurry re-circulating pumps & Oxidation blowers shall be located in a shed provided with roof sheeting. The buildings/structure must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.			
12.00.00	Contractor shall provide Corrosion protection painting for structures & equipments as described in the specification			
13.00.00	Contractors scope shall include all Platforms, walkways, staircase, safety rails for access of each equipment, valves, dampers, gates, instruments etc. handling facilities adequately each component of FGD system.			
14.00.00	The contractor scope shall also include the provision of FGD trestle for routing of air			
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-III-A1 FGD	Page 7 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	& water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations.			
15.00.00	Contractor shall provide air conditioning for the FGD control room and Analyser room (if separately provided) & ventilation for the FGD system buildings as detailed in Sub-Section III-A2.			
16.00.00	Contractor shall provide compressed air system for the FGD system as detailed in Sub-Section III-A2.			
17.00.00	Contractor shall provide FIRE FIGHTING SYSTEM as detailed in Sub-Section III-A3.			
18.00.00	Contractor shall provide EQUIPMENT COOLING WATER SYSTEM as detailed in Sub-Section III-A4.			
19.00.00	Contractor shall provide Limestone & Gypsum handling & storage system for FGD as detailed in Sub-Section III-A5.			
20.00.00	The scope of civil works shall be as per Sub-Section-III D.			
21.00.00	Associated Electrical and Control & Instrumentation systems for FGD as detailed in Sub-Section-IIIB & Sub-Section-IIIC respectively of Part-A/Section-VI of this specification.			
22.00.00	Booster Fan & Isolation Gates			
22.01.00	For each unit, two (2) nos. Booster Fans of axial type, Constant speed, variable pitch controlled each with drive motor, base plates, foundation bolts and nuts, inlet box, discharge case, coupling, coupling guard and suitable arrangement to prevent rain water entry to fan motor. Each Booster Fan shall be provided with bearing lubrication and hydraulic blade pitch control unit(s) consisting of (1) 2x100% oil pumps each with motor, coupling and coupling guard. (2) 2x100% oil coolers. (3) 2x100% filters, differential pressure switches, etc. (4) One (1) oil storage tank. (5) Instrumentation, vibration monitoring, inter connected piping, valves and fittings including pressure relief valves and non return valves. (6) Electrical actuator with accessories etc. Alternatively, a forced oil lubrication system (consisting of 1 to 6 above) common to bearing lubrication and for servo motor operation to each Fan will also be acceptable. At least two (02) nos. of duplex thermocouples or duplex platinum RTDs (100 ohm at 0°C) and one no. of temperature indicators shall be provided for bearing metal temperature measurement, control and monitoring. Booster fans shall be suitable for the type of foundation being provided. For Rourkela (1x250 MW) project, booster fan shall be provided only if the existing ID fan is not sufficient to take care of the pressure losses in the FGD system and its			
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-III-A1 FGD	Page 8 of 9

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
22.02.00	associated ducting. Further for Rourkela (1x250 MW) project FGD inlet gate, FGD outlet gate and bypass damper is not envisaged in the scope of contractor. Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions.			
23.00.00	Contractor shall provide Low Height Wet Chimney(s) as per the criteria & specifications specified elsewhere in the specification for the project. For Rourkela (1x250 MW) project, Low Height Wet Chimney is not envisaged.			
24.00.00	Wet Stack Condensate Collection System			
24.00.01	Wet stack shall be provided with a stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets/Gypsum coming out of the stack. Design of the wet stack condensate system should be such that all the condensate are collected in the stack itself and no water droplet/condensate come out of the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the plant/nearby area. For Rourkela (1x250 MW) project, Wet Stack Condensate Collection System is not envisaged in the scope of contractor.			
24.00.02	Drain piping shall be of suitable material from corrosion point of view.			
24.00.03	All Stack liquid collection shall be easily accessible for O&M.			
24.00.04	The design of the stack condensate collection system shall be provided by the bidders in its bid.			
24.00.05	Bidder should provide the condensate collection system such that the condensate collected shall be routed to absorber by gravity, bidder should ensure safe discharge to the absorber. However, in-case of the distance between absorber and wet stack is considerably far, bidder should provide the condensate collection system such that condensate shall be collected in a storage tank and pumped to absorber. Tank shall be placed at zero meter with a capacity 5 m3/hr along with associated pumping system. A common storage tank for all the units of storage capacity of 5 m3/hr of stack condensate of all the stacks shall be provided. However, separate tanks of similar capacity each may also be provided for different units/stages in case of layout/routing constraint. Storage tank(s) shall be complete with stack condensate collection be pumped to absorber. Contractor shall provide 2 X100% pumps for each tank, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty.			
24.00.06	Stack outlet liquid collector shall be designed in such a way so that the liquid condensate film near the exit of the stack is collected instead of carrying with the exit gas. Bidders shall provide all these details in its bid.			
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-III-A1 FGD	Page 9 of 9

SUB-SECTION-III-A2

**AIR CONDITIONING, VENTILATION SYSTEM &
COMPRESSED AIR SYSTEM**

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	AIR CONDITIONING SYSTEM a) General The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Air conditioning system consisting of D-X units with refrigerant piping & valves, Air handling units, Hi-wall split air conditioner /Cassette Air conditioners, Packaged Air Conditioners, Fresh air fans, air distribution system (ducting, filters, isolation dampers, motorized fire dampers, diffusers, grills, volume control dampers, etc.) etc., along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI. b) Air-conditioning system for F.G.D Control Room Building Air cooled condensing units (D-X type) type air conditioners with AHU of suitable capacity with 100 % redundancy (as per actual heat load calculation) shall be provided . c) SO2 analyzer room (if required) and other air conditioned offices/areas covered under this package shall be provided with Ductable/Non ductable Split air conditioners etc. as per Design criteria specified in Chapter Salient Design Data. Non ductable Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India. d) Supply of Mandatory spares as specified. e) Any additional items required to make the system complete. f) For Air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Bidder shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning system as per manufacturer's standard practice. However relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall be made available in FGD control system. Control and monitoring of air conditioning system from FGD control system is also acceptable. h) Apart from the above, any area/building which are in the scope of the bidder and require air conditioning, the same shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification.			
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-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM	Page 1 of 4	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनडीपीसी NTPC		
3.00.00	not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system as per manufacturer's standard practice. Control and monitoring of ventilation system from FGD control system is also acceptable. COMPRESSED AIR SYSTEM a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD plant each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15Nm³/min at discharge pressure of 8.5 Kgf/cm² (g). b) Two (2) numbers (1 working+ 1 standby) Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc. c) Two number Air Receiver each of capacity 2 m³ (normal) at the discharge of each Air compressor. d) Monorail with electric hoist of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more. e) Complete instruments, control system with panels as required for compressed air system. f) Complete compressed air and piping network for service air and instrument air application in FGD system shall be as per Tender drawing of compressed air system. g) Supply of Mandatory spares as specified. h) Any additional items required to make the system complete. NOTE: Compressor and Air dryer has not been envisaged for NSPCL Rourkela (1x250 MW). Tapping for Instrument air and Service air shall be taken from nearby existing header of compressed air system.			
4.00.00	General i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system. ii. Set of commissioning spares as may be required during erection and commissioning. iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder.			
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-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM	Page 3 of 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications. v. Any additional items required to make the system complete. vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc. vii. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer. Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.		
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-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM	Page 4 of 4

SUB-SECTION-III-A3

FIRE DETECTION & PROTECTION SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
1.00.00	FIRE DETECTION AND PROTECTION SYSTEM: The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Fire Detection and Protection System for FGD area. Following system has been envisaged: 1.1 Hydrant System: Complete hydrant system (pipe, hydrant valves, landing valves, water monitors, hoses, branch pipes and nozzles etc) for FGD area shall be provided as per TAC norms. Tapping for hydrant system shall be provided from nearby existing hydrant header. 1.2 HVW Spray System: Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this package. Tapping for HVW spray system shall be provided from nearby existing spray header. 1.3 MVW Spray System: Automatic fire detection cum medium velocity water spray system for the various cable galleries envisaged under this package. Tapping for MVW spray system shall be provided from nearby existing Spray header. 1.4 Fire Extinguishers The contractor shall supply the following quantity (minimum) of fire extinguishers and install the same at various locations of FGD system as per TAC requirement. 1. Pressurized water type (9lit. capacity as per IS 15683): 5 nos 2. CO₂ type (4.5 kg Cap IS:15683): 5 nos 3. Dry chemical type (6 kg Cap IS:15683) : 5 nos 1.5 Analogue addressable type Fire Alarm System / Annunciation Panels: Analogue addressable type Fire Alarm System consisting of Multi sensor type detectors, Linear Heat Sensing Cable (LHSC) detector, cabling, junction boxes, instrumentation, Fire Alarm cum control panels, repeater panels, etc. for various areas/equipment as detailed out below:- a) All MCC / switch gear room / Control room shall be provided with Multisensor type detectors. b) All Conveyors and Cable Galleries shall be provided with Linear Heat Sensing Cable detectors. c) All cable galleries shall be provided with Multisensor type detectors. 1.6 The Contractor is responsible for getting the complete approval of the system elaborated in this specification from TAC accredited professional(s). 1.7 If the contractor feels, it is necessary to include any other items, which, in his opinion, may be required to comply with TAC regulations, other than those indicated in the specification, the same shall also be supplied, erected and commissioned. Any amendments, modified rules to the latest TAC			
LOT 2 FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-III-A3 FIRE DETECTION & PROTECTION SYSTEM	Page 1 of 2

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	regulations till techno-commercial bid opening date should be considered by contractor to fulfill the above condition. 1.8 Successful contractor shall furnish complete hydraulic calculation. 1.9 Supply of complete mandatory spares as specified elsewhere. 1.10 Set of commissioning spares as may be required during erection and commissioning. 1.11 One (1) set Special tools and tackles required for maintenance of all the mechanical, electrical and C & I equipment under the scope of Contractor. 1.12 Any additional item/ equipment required to make the system complete. 1.13 Grouting, dressing and final finishing of all foundations of various equipment, etc. 1.14 Supply of structural supports for piping in trench and for above ground piping wherever applicable. 1.15 Supply & application of protective coatings and wrapping for buried pipes and pipes in RCC trenches, and painting for above ground piping, valves, pipe supports, etc. as detailed in technical specifications. 1.16 Excavation, preparation of bed, laying, backfilling with compaction of soil for all underground/buried piping. Also, breaking and re-erection of paving for buried piping (if any) 1.17 Preparation of necessary detailed drawings including schematics, layouts, isometrics, fabrication drgs, erection drgs, etc. as required and also development of “As Built Drgs”. 1.18 Conductance of Performance and Guarantee test as per Standard Guaranteed test procedure given elsewhere in the specification. 1.19 All pylons required for transformers, shall be anchored to soak pit base slab of individual transformer, paved area outside soak pit, etc. using anchor fasteners of adequate capacity. Subsequent to fixing the pylons, lower part of pylon which would be within filled up gravel portion shall be encased with concrete by Employer for corrosion protection.			
LOT 2 FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-III-A3 FIRE DETECTION & PROTECTION SYSTEM	Page 2 of 2

SUB-SECTION-III-A4

EQUIPMENT COOLING WATER SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES एनटीपीसी NTPC		
1.00.00 1.01.00	EQUIPMENT COOLING WATER SYSTEM FOR KBUNL MUZAFFARPUR TPS-II (2 X195 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. (a) One cold-water header tapped from CW Blowdown from CW pump discharge pipe. (b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to CW blow down header shall also be provided. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. (e) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (g) One Overhead DM water tank (ECW O/H tank). (h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 1 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES एनटीपीसी NTPC		
2.00.00 2.01.00	EQUIPMENT COOLING WATER SYSTEM FOR SIPAT STPP-I (3 X660 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. - One cold water header tapped from CW Blowdown from the existing blow down header available near FGD area. - Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to CW blow down header shall also be provided. 2x100% capacity self-cleaning strainers on the secondary side. 4 x 50% (3 working + 1 standby) capacity of plate type heat exchangers. 5 x 50% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. 4 x 50% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. - One Overhead DM water tank (ECW O/H tank). - Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. - Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 2 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
3.00.00 3.01.00	EQUIPMENT COOLING WATER SYSTEM FOR TSTPP-I & II (2X500MW) & (4 X500 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. (a) One cold water header tapped from CW Blowdown from the existing blow down header available near FGD area. (b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to CW blow down header shall also be provided. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 7 x 50% (6 working + 1 standby) capacity of plate type heat exchangers. (e) 8 x 50% (6 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 7 x 50% (6 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (g) One Overhead DM water tank (ECW O/H tank). (h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.			
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 3 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES एनटीपीसी NTPC		
4.00.00 4.01.00	EQUIPMENT COOLING WATER SYSTEM FOR BHILAI TPP-II (2 X250 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. (b) One cold water header tapped from CW Blowdown from CW pump discharge pipe. (b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to CW blow down header shall also be provided. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. (e) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (g) One Overhead DM water tank (ECW O/H tank). (h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 4 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	EQUIPMENT COOLING WATER SYSTEM FOR ROURKELA TPP (1 X250 MW)			
5.00.00	SCOPE			
5.01.00	Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. (a) One cold water header tapped from CW Blowdown from the existing blow down header available near FGD area. (b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to CW blow down header shall also be provided. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 2 x100% (1 working + 1 standby) capacity of plate type heat exchangers. (e) 3 x 100% (1 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 2 x 100% (1 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (g) One Overhead DM water tank (ECW O/H tank). (h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 5 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
6.00.00	EQUIPMENT COOLING WATER SYSTEM CUM WATER PRETREATMET PLANT FOR SIMHADRI STPP-I AND II (2x500MW) AND (2x500MW)			
6.01.00	Broad scope of work described below shall be read in conjunction with the Data Sheets enclosed as Annexure-1. The technical parameters of various equipments shall be referred in the data sheets enclosed with this subsection as Annexure-1 .			
6.02.00	General Philosophy of Control & Operation of Water Treatment Plant is described in Annexure-2 of this sub-section			
6.03.00	WATER PRE-TREATMENT PLANT			
a)	2 X100 % Raw water pump of 550 m3/hr capacity to be installed at Raw (sweet water) water pump house of Simhadri STPP St-II (2X500MW), necessary pipe and valve for suction header to newly installed pumps, a pipe [Carbon (CS) Steel Pipe] from the discharge of FGD raw water pumps to the aerator through a set of Control Valve & Isolation Valves for Control Valves.			
b)	One (1) number Aerator and one (1) number stilling chamber of RCC Construction of capacity as mentioned in the data sheets along with isolation gates at the inlet to the inlet channels for clarifier.			
c)	Two (2) numbers of inlet channels with flow measuring element in each channel (parshall flume) of RCC Construction.			
d)	One number bypass channel of RCC Construction to by-pass clarifier(s) with required isolation gate(s)			
e)	Two (2) numbers of reactor type clarifiers (Both working) of RCC Construction each of capacity as mentioned in the data sheets including associated equipment and drives.			
f)	Outlet channels of RCC Construction from Clarifiers up to the Clarified Water Storage Tank.			
g)	Interconnection between the clarified water outlet channel and outlet channel Existing clarifier.			
h)	One (1) number Clarified Water storage tank /Distribution Chamber of RCC Construction of capacity /sizes as mentioned in the data sheets with required isolation Valves.			
i)	Necessary piping, valves, control and instrumentation etc arrangement for Tap off from the existing chlorine dosing system of St-I /St-II.			
j)	2x100% capacity self-cleaning strainers to be installed after auxiliary cooling water pumps.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 6 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
k) l) 6.04.00 6.05.00	6 x 50% (4 Working + 2 standby) capacity auxiliary cooling water pumps, its drives, associated suction pipes from clarified water distribution chamber/tank, isolation valves, pump(s) discharge pipes(CS), non-return valves & isolation valves at the discharge and discharge pipe line to PHE etc. Contractor shall take full responsibility that all materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with the respective fluids herein. Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. a) One cold water header tapped from clarified water storage tank. b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to ACW tank shall also be provided. c) 5 x 50% (4 working + 1 standby) capacity of plate type heat exchangers. d) 5 x 50% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. e) One Overhead DM water tank (ECW O/H tank). f) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. g) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per CI no-14.09.00 Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system. Chemical House Equipments a) Preparation and dosing system equipments shall be installed in the existing chemical house of the stage-II. Existing Electrically operated monorail hoists shall be used for transporting the chemicals from the ground floor to the respective preparation tanks and required number of weighing scales. b) Lime preparation & dosing system consisting of required number of RCC lime slaking tanks, RCC lime solution preparation tanks, agitators, lime slurry transfer pumps, lime solution dosing pumps complete with all necessary			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 7 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc as mentioned data sheets enclosed in Annexure-1 of this sub-section.. e) Alum Solution preparation & dosing system consisting of required number of RCC Alum solution preparation tanks, agitators, alum solution dosing pumps complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc as mentioned data sheets enclosed in Annexure-1 of this sub-section. d) PE dosing system consisting of required number of tanks, agitators, dosing pumps complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc. Coagulant aid (Poly electrolyte) Preparation tank: Each tank shall be sized for holding coagulant for minimum 12 hours requirement of all the clarifiers operating at design capacity and a design dosage rate of 2 ppm minimum. 6.06.00 LIQUID EFFLUENT TREATMENT SYSTEM 6.06.01 PT- Clarifier Sludge Disposal System a) One number RCC sludge pit (2 sections) to collect sludge from all the clarifiers of required capacity as specified in data sheet, sludge piping from clarifier upto the pit, associated valves etc. b) Two (2) numbers sludge disposal pumps of required capacity as specified in data sheet, its drives, associated valves, piping etc from the discharge header of above pumps upto the Terminal point. c) Two numbers of air blowers of oil free type of capacity as mentioned in the data sheets, its drives and associated accessories, air (Galvanised CS) piping from blowers to each section of the sludge pit for air scouring of sludge.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 8 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES एनटीपीसी NTPC			
6.07.00	ANNEXURE-1 DATA SHEETS FOR PRETREATMENT PLANT FOR SIMHADRI STPP NO. DESCRIPTION PT System I INLET PIPE, CONTROL VALVES & ISOLATION VALVES I –A) INLET PIPE 1) Size ----- Refer Tender Drawing ----- 2) Material of Construction Carbon steel Carbon steel I –B) ISOLATION VALVES 1) Size ----- Same as that of pipe size ----- 2) Type -----Manually operated Butterfly Valves----- 3) Design Code -----Refer Technical Specification----- II AERATOR, STILLING CHAMBER AND INLET CHANNEL II –A) Aerator PT System 1) Type -----Cascade Type ----- 2) Number One 3) Material of Construction RCC 4) Design Flow 460 m³/hr + 3% for sludge II –B) Stilling Chamber 1) Number One 2) Material of Construction ----- RCC ----- 3) Type of Construction -----Circular / Rectangular ----- 4) Design Flow 460 m³/hr + 3% for sludge 5) Retention time 1 min. II –C) Inlet Channel 1) Number 2			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 9 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC
	NO.	DESCRIPTION	PT System
	2)	Material of Construction	----- RCC -----
	3)	Design Flow	460 m ³ /hr + 3% for sludge
	II)	CLARIFIERS	
	1)	Type	----- Circular Reactor type -----
	2)	Number	2
	3)	Design Flow	460 m ³ /hr
	4)	Material of Construction	----- RCC -----
	5)	Material of pipe from Inlet channel to clarifier	Carbon steel pipe encased with concrete for buried portion and externally epoxy painted inside the clarifiers
	6)	Sludge Blow-off to Sludge Sump	
		a) Type	----- By gravity -----
		b) Pipe material	----- C I Class A as per IS : 1536 -----
		c) Constant Bleed arrangement With telescope device	----- Required -----
		d) Flushing connection	----- Required -----
	7)	Reaction Turbine	With variable frequency drive as per Manufacturer's Standard
	8)	Clarifiers Scrappers	
		a) Number	-----One assembly per Clarifier -----
		b) Material of construction	----- Mild steel with rubber inserts ----- (with bitumastic paint protective coating)
		c) Drive	Slow speed Motor driven through reduction gear unit or variable frequency drive as per manufacturer's standard
	9)	Overflow Weir/Notch	
		Location	-----To be fixed in the radial launders of Clarifier-----
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 10 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एन टी पी सी NTPC
	NO.	DESCRIPTION	PT System		
		Material	----- Mild steel/RCC -----		
	III)	CLARIFIED WATER STROGE TANK/DISTRIBUTION CHAMBER AND PUMP			
	1)	Number of Storage tank	One		
	2)	Material of Construction	RCC with cover		
	3)	Size (Minimum) & Capacity of Tank	150 m3		
	4)	Size of Pump House	Refer Tender Drawing		
	IV)	SLUDGE PIT/SUMP & PUMP (Common for all the clarifiers)			
	1)	Number of Sludge pits	One in two sections with common sump interconnected through Valves		
	2)	Material of Construction	RCC		
	3)	Effective capacity of each section	90 m3		
	4)	<u>SLUDGE PUMP</u>			
	1)	Pumps	2 nos (1 W+1 S)		
	2)	Air Scour Blowers	2 nos (1W+1S), Flow and head as required.		
	V)	CHEMICAL HOUSE EQUIPMENTS			
	X-3)	Chemical Tanks	Lime Slaking Tanks	Lime Solution Preparation Tanks	Alum Solution Preparation Tanks
	1)	Number	Two (2)	Two (2)	Two (2)
	2)	Material of construction	RCC (with 2 coats of bitumastic paint over 2 coats of primer)		RCC (with Acid/Alkali resistant tiles)
	3)	Effective Capacity of each tank	10 Cu.M at 10% W/V	10 Cu.M at 6% W/V	10 Cu.M at
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	
				PAGE 11 OF 88	

CLAUSE NO.		SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC	
		strength	strength	10%W/V strength	
4)	Agitator & Number	Motor driven with reduction gear unit ; One per tank			
5)	Dissolving Chamber for each tank	-----Required (Stainless steel Material) -----			
6)	Agitator shaft Material	----- SS -316 -----			
7)	Agitator Impeller Material	----- SS-316 -----			
VI) DATA SHEET OF PUMPS					
VI-1) Vertical Sump Pumps					
NO	DESCRIPTION		PARAMETERS		
1)	Designation	:	Sludge Pumps (Clarifiers)		
2)	Location	:	In Clarifier Sludge sump		
3)	Total Number of Pumps	:	Two (2)		
4)	Number of operating pumps	:	One (1)		
5)	Number of stand by pump	:	One (1)		
6)	Guaranteed Flow of each pump	:	60 Cu.M/hr		
7)	Total head (Guaranteed)	:	20Mwc(Minimum)		
8)	Operating Speed	:	-----Max 1500 rpm-----		
9)	Pumps & Drives to be designed for	:	----- Outdoor Duty -----		
10)	Service of duty	:	----- Intermittent -----		
11)	Type of pump	:	-----Vertical, non-clog, Sump pumps -----		
12)	Type of Working Fluid	:	Sludge Water with particle size upto 10mm		
13)	Type of Discharge	:	----- Above Floor discharge -----(With Separate discharge pipe in addition to the column pipe)		
14)	Type of impeller	:	----- Open -----		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	
				PAGE 12 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
	15) Type of lubrication : ----- Grease ----- 16) Suction condition : ----- Submerged ----- 17) Minimum Water level : -----By Bidder ----- 18) Maximum Water level : ----- Local Finished Grade level----- 19) Operating floor level : -----Minimum 500 mm above FGL----- 20) Type of shaft coupling : -----Flexible / Rigid ----- 21) Material of Construction : a) Suction Bell /Casing : 2% Nickel Cast Iron, IS: 210 Grade FG 260; S-0.1% max. P-0.15% max. b) Impeller : ASTM A351 CF8M c) Shaft : ----- SS-410 ----- d) Shaft coupling : ----- SS-410 ----- e) Shaft sleeves : ----- SS-410 ----- f) Column pipe & Discharge Pipe : CS as per IS: 2062 or Eq g) Shaft enclosing tube(if applicable) : -----do ----- h) Stuffing box : 2% Nickel CI,IS:210 Grade FG 260; i) Gland : 2% Nickel CI,IS:210 Grade FG 260; j) Gland packing : -----TIWA ----- k) Gaskets : ----- Neoprene Rubber ----- l) Bolts & nuts : Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel. m) Base plate and Soleplate : Carbon steel (Minimum 10 mm thick)	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 13 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	(VII) – Horizontal Centrifugal Pump			
	NO	Designation	:	Raw water Pump
	1)	Location	:	Raw (sweet water) water pump house of St-II(2X500MW)
	2)	Total Number of Pumps	:	Two(2)(1W+1S)
	3)	Guaranteed Flow of each pump	:	550 Cu.M/hr
	4)	Total head (Guaranteed)	:	40 MWC (Minimum)
	5)	Operating Speed	:	----- 1500 rpm (nominal) ----- -----
	6)	Pumps and drives to be designed for	:	----- Outdoor Duty -----
	7)	Service of duty	:	-----Continuous -----
	8)	Type of pump casing	:	-----Preferably Radially Split type ---
	9)	Type of Working Fluid	:	Clarified water /Treated water Treated Effluent
	10)	Maximum water temperature	:	45 deg C
	11)	Minimum water temperature	:	33 deg C
	12)	Type of impeller	:	-----Closed / Semi Open --
	13)	Type of lubrication	:	-----Grease -----
	14)	Suction condition	:	-----Flooded suction --
	15)	Type of Shaft Sealing	:	-----Gland Packing -----
	16)	Type of coupling (motor & pump)	:	-----Flexible -----
	17)	Type and quantity of Suction Strainers	:	-----Not Applicable -----
18)	Material of Construction :			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 14 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एनटीपीसी NTPC
	i) Casing : ---- 2.5% Ni Cl IS210 Gr FG 260 ----- ii) Impeller : ASTM A351 CF8M Wearing rings (if applicable) : SS – 316 iii) Shaft : SS-410 iv) Shaft sleeves : SS- 410 v) Stuffing box : ----- 2.5% Ni Cl IS210 Gr FG 260 - vi) Gland : ----- 2.5% Ni Cl IS210 Gr FG 260 - vii) Gland packing : TIWA viii) Mechanical Seal : ----- Not Applicable ----- ix) Gaskets : Neoprene Rubber x) Bolts & nuts : Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel. xi) Base plate : ----- Carbon steel ----- 21 Accessories to be provided with each pump : a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Positioning dowels, drain plugs, vent valve etc c) Coupling guards, Eye bolts, lifting etc. 22 Other Technical Requirements : Refer sub-section titled “Horizontal Pumps” in Part-B of Technical Specification NO Designation : Lime Slurry Transfer Pumps Lime Dosing Pumps 1) Location : Existing Chemical House Existing Chemical House 2) Total Number of Pumps : Two (2) Two (2)				
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 15 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC
	3) Number of operating pumps : One (1) One (1) 4) Number of stand by pump : One (1) One (1) 5) Guaranteed Flow of each pump : 10 Cu.m/hr 10 Cu.m/hr 6) Total head (Guaranteed) : As required As required 7) Operating Speed : ----- 1500 rpm (nominal) ----- 8) Pumps and drives to be designed for : -----Outdoor Duty ----- 9) Service of duty : -----Continuous ----- 10) Type of pump casing : -----Preferably Radially Split type ----- 11) Type of Working Fluid : Clarified Water Lime Solution (10% w/v) Lime Solution (6% w/v) 12) Maximum water temperature : 36 deg C 80 deg C 13) Minimum water temperature : 15 deg C 40 deg C 14) Type of impeller : ----- Semi open ----- 15) Type of lubrication : -----Grease ----- 16) Suction condition : -----Flooded suction ----- 17) Type of Shaft Sealing : -----Gland Packing ----- 18) Type of coupling (motor & pump) : -----Flexible ----- 19) Type and quantity of Suction Strainers : -----Y strainer ,2 nos----- 20) Material of Construction : i) Casing : ----- 2.5% Ni Cl IS210 Gr FG 260 ----- ii) Impeller : SS – 316 SS – 316	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
PAGE 16 OF 88		

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	Wearing rings (if applicable)	:	SS – 316	SS – 316
	iii) Shaft	:	SS-410	SS-410
	iv) Shaft sleeves	:	SS- 410	SS- 410
	v) Stuffing box	:	----- 2.5% Ni Cl IS210 Gr FG 260 -----	
	vi) Gland	:	----- 2.5% Ni Cl IS210 Gr FG 260 -----	
	vii) Gland packing	:	TIWA	
	viii) Mechanical Seal	:	----- Not Applicable -----	
	ix) Gaskets	:	Neoprene Rubber	Neoprene Rubber
	x) Bolts & nuts	:	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel.	
	xi) Base plate	:	-----Carbon steel -----	
	21 Accessories to be provided with each pump	:	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Positioning dowels, drain plugs, vent valve etc c) Coupling guards, Eye bolts, lifting etc.	
	22 Other Technical Requirements	:	Refer sub-section titled “Horizontal Pumps” in Part-B of Technical Specification	
(IX) – METERING PUMPS – ALUM DOSING PUMPS				
NO	Designation	:	PT System	
1)	Total Number of Pumps	:	Two (2)	
2)	Number of operating pumps	:	One (1)	
3)	Type	:	-----Simplex hydraulically operated Diaphragm type -----	
4)	Capacity (minimum)	:	1000 liters /hour	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
				PAGE 17 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 
	5) Head : As required 6) Liquid to handled and concentration : ----- Alum solution 10% W/V ----- 7) Capacity control : 10 --100% of capacity manually by micrometer dial 8) Pump stroke speed per minute : ----- Maximum 100 ----- 9) Material of Construction: a) Liquid end (pump head valve, valve housing, etc) ,valve spring : ----- AISI -316 ----- b) Diaphragm : ----- PTFE ----- c) Packing : ----- PTFE ----- d) Shaft : ----- Hardened steel EN8-BS-970)/ AISI-316 ----- 10) Accessories : Pressure Dampeners, Safety Relief valves etc required 11) Other Technical Requirements : Refer sub-section titled “Metering Pumps” in Part-B of Technical Specification
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 18 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	ANNEXURE -2 6.08.00 CONTROL & OPERATION PHILOSOPHY 6.08.01 GENERAL All the systems PT covered under this package shall be controlled as mentioned in relevant Sub-sections of Control & Instrumentation. The required instruments are generally shown in the relevant tender P & ID. However, additional instruments/limit switches etc required to meet the intended control scheme/ philosophy and to meet the system requirement shall be provided by the Contractor within the Contract price. The Instrumentation & Control system shall be provided as indicated in various subsections of this Technical specification. The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalised with successful bidder during detailed engineering. 6.08.02 CONTROL PHILOSOPHY 6.08.02.01 General: The control philosophy of various systems are described below. However for all the systems, following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement. a) Among the equipments, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc through control system. b) <u>Permissive & Interlocks:</u> 1) Starting & tripping of pumps with respect to liquid level in the respective sump/tanks or liquid pressure in the suction lines. 2) Starting & tripping of agitators with respect to liquid level in the respective sump/tanks. 3) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be). 4) Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 19 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
6.08.02.02	5) Stopping/ tripping of equipments due to abnormal parameters related to safety of equipments like high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc as applicable based on the recommendations of Equipment Supplier. 6) Automatic opening of the pump re-circulation valve to pre-set percentage, in case of failure of opening of pump discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer. 7) Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be. c) <u>Alarms /Signals</u> 1) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc. 2) Failure of starting of equipments such as pumps, blowers etc. upon start command. 3) Tripping of equipments due to protection logic. 4) In addition, the control system shall facilitate the operator to know the status of various equipments (Whether equipment is running or stopped or tripped etc, whether the equipment is selected for operation/ standby duty /maintenance mode etc as the case may be).			
	Apart from the general philosophy mentioned above, following shall also be required to be implemented through control system. i) <u>Clarification Plant</u> 1) Raw Water Flow (0 to 100%) through the Clarifiers of PT System shall be regulated automatically by means of inlet control Valve (s) with respect to the Water level in the Clarified Water distribution Chamber /Clarified water storage tank as the case may be. 2) It shall be possible for the operator to take over flow regulation control manually from the OWS so that as per the plant requirement, operator may regulate the control valve opening.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 20 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	3) A variable frequency drive (VFD) shall be provided for turbine / impeller drive of all the clarifiers to control the speed for varying the recirculation rate. The VFD system shall be able to accept 4-20 mA signal from the Control system and shall provide 4-20 mA feedback signal for use in Control System. 4) The scrapper drives of clarifiers shall be interlocked with torque limit switches on the motors. 5) Isolation of clarifier (closure of inlet/ outlet gates of Clarifiers), Bypass condition of Clarifiers and open condition of clarifier interconnection shall be communicated to the operator through control system and Chemical dosing shall be prevented by closing the valves in dosing lines to the clarifier (s) which is (are) isolated / bypassed. b) <u>Chemical House</u> 1) The chemical tank which is proposed to be used for preparation and supply of chemicals at any instant shall be selectable through control system.. 2) Capacity of the metering pump shall be controllable from 10 -100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0 – 100% of pump capacity integral with the pump. 3) In addition to the remote controlling facility, the facility of local operation of all the metering pumps, lime transfer pumps, lime dosing pumps, agitators of various tanks etc. and associated indicators & alarms is envisaged under employer’s DDCMIS. Option for local / remote control shall be selected through OWS of the control system. c) <u>Clarifier Sludge pit and pumping scheme:</u> At a specific water level in the sump, selected pump (s) shall start and sludge shall be pumped out to the ash slurry sump. In case of high level in ash slurry sump, isolation valve at the sludge discharge piping header shall be closed and the pump shall work in re-circulation mode by opening of recirculation valve, till the level in the ash slurry pump reduces to receive sludge However, pump recirculation mode shall not be continued beyond a specified time limit of approximately 10 -20 minutes.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 21 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
7.00.00	EQUIPMENT COOLING WATER SYSTEM CUM PT AND DESALINATION PLANT FOR NTECL (VALLUR) TPP (3 X500 MW)		
7.01.00	GENERAL a) Brief scope of work described below shall be read in conjunction with the Data Sheets enclosed as Annexure-1. b) General Philosophy of Control & Operation is enclosed in Annexure-2 of this Sub-Section.		
7.02.00	PRE- TREATMENT SYSTEM a) CW blow down water pipe tapped at the nearest point from CW blow down header to CMB to a stilling chamber, one set of Control Valve, its bypass valve and Isolation Valves for Control Valves. b) One (1) number stilling chamber of capacity as mentioned in the data sheets c) Two (2) numbers of clarifier inlet channels with flow measuring element (parshall flume) in each channel with isolation gates and one by-pass channel with necessary isolation valve. d) Two (2) numbers tube settlers/ lamella type clarifiers (both working) each of capacity as mentioned in Data sheets provided with flash mixers, flocculation chambers & associated agitators/ rapid mixers etc. e) An above ground located RCC clarified sea water storage tank of capacity as mentioned in the data sheets to store clarified Sea Water supplied from Clarifiers, and two outlet channels (with isolation gates / valves as shown) for interconnection of clarifiers and clarified sea water storage tank. f) Three (3) numbers of Filter Feed pumps of capacity as mentioned in the data sheets with electrical motor drives, suction & discharge pipe header, valves and all accessories. g) Interconnecting Pipe from Filter Feed pumps to filtration system. h) TWO(2) stage Filtration system in series comprising of Dual media (1st Stage) filters (N+2) and Cartridge type (2nd Stage) filters (N+2), associated, piping, valves etc, i) ULTRA-FILTRATION SYSTEM 1. N+1 number of UF feed pumps with electric motor and variable frequency drive (VFD). N is the number of working pumps and 1 is the standby pump.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 22 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	2. 2x100% common Self-Cleaning strainers or 3X50% Self-Cleaning strainers common at the upstream of all UF train/stream. 3. N+2 number of UF trains/streams/skids where N is the number of Working streams and 2 is the number of stand-by streams. One (1) number UF permeate water storage tank. 4. One (1) number UF permeate water storage tank of capacity of 10 Minutes retention. 5. N+1 number of UF backwash pumps with electric motor and variable frequency drive (VFD) 6. Complete CEB, CIP & flushing systems 7. N+1 number of UF permeate transfer pumps with electric motor drive 8. Required number of Blowers with electric motor drive (If applicable) 9. Associated piping, valves, fittings, equipment etc. 10. Emergency safety showers with eye wash units in the Chemical Storage Handling facility at each locations such as Acid/Alkali Storage area, Chemical storage area and Chemical preparation & doing equipment area. j) All pumps & blowers in Ultra-filtration/(Desalination) system shall be designed with a redundancy of N+1 unless stated otherwise. (N=No. of Working pumps, blowers.) k) Interconnecting piping, Valves etc between filtration system and suction header of SWRO plant. l) One number RCC sludge pit of required capacity as specified in data sheet to collect sludge from the clarifiers, sludge piping from clarifier upto the pit, associated valves, ladder/platform outside for inspection and removable type ladder/platform for inside sump/tank maintenance etc. m) Two (2) numbers sludge disposal pumps of required capacity as specified in data sheet, its drives, associated valves, piping etc from the discharge header of above pumps upto the brine water storage tank. n) Filter backwash water pumps of capacity as mentioned in the data sheets with electrical motor drives, suction & discharge pipes, interconnecting pipes from pumps to each filter, contaminated waste water from filters upto the terminal point o) Filter Blowers of required capacity with electrical motor drives, suction & discharge pipe header, valves, accessories etc.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 23 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
7.05.00	ii. One (1) number of clarified water storage tank with all accessories, discharge/outlet pipes from the tanks to form suction header for feeding to various Auxiliary cooling water (ACW) pumps for FGD plant use. iii. Any additional system required to meet the water quality as recommended by FGD system provider iv. Interconnecting piping, valves, fittings etc associated with brine water collection & disposal system to respective storage tanks/ pumps/ etc.			
	RO (2ND STAGE) SYSTEM a) Three numbers of High Pressure (HP) -RO feed pumps with electric motor drives, suction header from discharge header of SWRO (1ST RO) & discharge pipe header, valves, accessories etc associated piping, valves, fitting etc. b) Three (3) (2 W+ 1 S) numbers of cartridge filtration units c) Three (3) (2 W+ 1 S) numbers of RO Streams/trains module rack assemblies complete with permeators, sampling facilities and automatically operated brine control valves, piping, fittings etc d) Complete system for chemical cleaning and Flushing system comprising the necessary tanks and pumps for RO trains/streams. e) Complete suck back arrangement along with Permeate booster pumps (If applicable) and Single membrane testing skid. f) One (1) numbers of Permeate water storage tank, discharge/outlet pipes from the tanks to form suction header for feeding to suction of ACW/Permeate water pump for FGD use. g) Reject water piping from 2nd stage RO trains to the Brine water storage tank. h) Interconnecting piping, valves, fittings etc. i) Any other equipments required to meet the System / Technical Specification requirement. k) EOT crane provided in RO Plant facility building (refer clause 10.03.00 (vii) above) shall be used for handling equipments of 2nd stage RO system.			
7.05.00	Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all three units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification. a) One cold water header tapped from 2nd stage RO permeate/ACW storage tank.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 25 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
7.06.00	(b) Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to permeate water tank shall also be provided. (c) 4 x 33.33% (3 working + 1 standby) capacity of plate type heat exchangers. (d) 5 x 33.33% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (e) 4 x 33.33% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (f) One Overhead DM water tank (ECW O/H tank). (g) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (h) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and structural steel shed for housing various equipment of Equipment cooling water system along with necessary handling arrangement as per CI no-14.09.00, Sub-section-M1, Part-B, Section-VI and electrical equipment as required and as specified for the system and electrical equipment as required and as specified for the system.			
	CHEMICAL STORAGE & DOSING SYSTEM 1) Two numbers of Coagulant unloading cum transfer pumps, its drives, required suction & discharge piping, valves, fittings etc. 2) Two numbers of Bulk Coagulant storage tanks, required structures, operating platforms, ladders, etc, 3) Two numbers of Coagulant preparation tanks & its accessories 4) Two numbers of Coagulant dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc, dosing piping from the pumps upto the flash mixer,/ inlet channel of clarifiers as the case may be and as required for the process. 5) Two numbers of Coagulant aid preparation tanks & its accessories 6) Two numbers of Coagulant aid dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc, dosing piping from the pumps upto the flocculation chamber of clarifiers as the case may be and as required for the process. 7) Two numbers of Anti-scalant preparation tanks & its accessories			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 26 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	8) Four numbers of Anti-scalant dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc, dosing piping from the pumps upto the dosing point as required for the process. 9) Two numbers of Anti-oxidant preparation tanks & its accessories 10) Four numbers of Anti-oxidant dosing pumps, its drives, required suction & discharge piping, valves, fittings, etc, dosing piping from the pumps upto the dosing point as required for the process. 11) Two numbers Hydrochloric Acid unloading cum transfer pumps, its drives, required suction & discharge piping, valves, fittings etc. 12) Three numbers of Bulk storage tanks for Hydrochloric acid of 30-33% concentration & its accessories 13) Three numbers of Acid (HCl) preparation tanks & its accessories 14) Two numbers of Acid (HCl) measuring tanks & its accessories 15) Two numbers each for Acid (HCl) dosing pumps for pH control of RO(2nd stage),SWRO(1st Stage) and UF system, its drives, required suction & discharge piping, valves, controls etc, dosing piping from the pumps upto wherever pH control is required as per process requirement. 16) Two numbers of Sodium Hydroxide (Alkali) unloading pumps, its drives, required suction & discharge piping, valves, fittings etc. 17) Two numbers of Sodium Hydroxide (Alkali) transfer cum re-circulation pumps, its drives, required suction & discharge piping, valves, fittings etc. 18) Two numbers of Bulk storage tanks for Alkali (NaOH in lye form), operating platforms, ladders, etc, 19) One number of Alkali preparation tank & its accessories 20) One number of Activated Carbon filter for Alkali & its accessories 21) Two numbers of Alkali measuring tanks for pH control of RO System & its accessories 22) Two numbers each for Alkali (NaOH) dosing pumps for pH control of RO(2nd stage),SWRO(1st Stage) and UF system, its drives, required suction & discharge piping, valves, fittings, etc, dosing piping from the pumps upto dosing point wherever pH control is required as per process requirement.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 27 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
7.07.00	23) Chlorination (if required) shall be suitably taped off from the existing CW chlorination system located nearby CW pump house alongwith necessary piping, valve, control & instrumentation etc. 24) Required number of electrically operated mono-rail hoist to handle chemicals from ground floor to first floor for chemical preparation with lifting bar, trolleys etc for ease of handling of various chemicals. 25) Required number of lifting bar, dial type load indicator, electrically operated mono rail hoists for handling chlorine tonners, 26) Weighing scales at ground floor and in first floor of Chemical House for weighing of chemicals being handled during storage and preparation. 27) Required platform, ladders etc to facilitate approach to various tanks, manholes/hand-holes, sight-glass, operation & maintenance of valves, instruments etc shall be provided. 28) One number emergency safety showers with eye wash units in the Chemical Storage Handling facility at each locations such as Acid/Alkali Storage area, Chemical storage area, Chemical preparation & dosing equipment area. 29) All Interconnecting piping, valves, fittings etc 30) Any other equipments required to meet the System / Technical Specification requirement			
	MISCELLANEOUS Contractor shall take full responsibility that all materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with sea water/permeate water and the respective fluids herein. All the fasteners like Nuts, Bolts etc. of Duplex material.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 28 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनडीपीसी NTPC	
7.08.00	ANNEXURE-1			
	TECHNICAL DATA SHEETS NTECL (VALLUR) TPP (3 X500 MW)			
	1-A) FOR DETAILS OF EQUIPMENTS OF COOLING WATER (ECW) SYSTEM (ACW, DMCW PUMPS, PHE ETC. PLEASE REFER THE ECW SECTION OF PART-B.			
	(1-B)- CLARIFIED (RO PERMEATE)/ACW WATER STORAGE TANK			
	No	Description	Parameters/ Data	
	1)	Fluid to be Stored	Clarified (RO permeate) Water produced from 2 nd RO Plant	
	2)	Type of Tanks	Vertical Cylindrical Atmospheric	
	3)	Design Standard	IS :803	
	4)	Size of Tank	12 m (diameter) x 6 m (Ht)	
	5)	Numbers required	One (1)	
	6)	Location	Outdoor	
	7)	Shell material	Mild Steel as per specified code	
	8)	Shell thickness (minimum)	As per IS : 803	
	9)	Bottom Plate Thickness (minimum)	10 mm	
	10)	Roof Plate Thickness (minimum)	6 mm	
	11)	Internal Protection	Solvent free epoxy coating	
	12)	Manhole	Minimum 2 numbers (one on the shell and other on the roof)	
13)	Accessories	a) Stair-case & platform b) Vent, Overflow and drain connections c) Overflow seal e)Hand railing on the roof of the tank all around the tank		
14)	Design Drawl rate from the Tank	800 Cum/hr		
15)	Filling connection Size	To be decided by Bidder.		
16)	Additional nozzle connections for Employer (<i>indicative sizes</i> are given below; Actual Size shall be decided during detailed engineering - Spare connections shall be provided with blind flange)			
	a) To Suction Header	2 (500 mm NB & 300 mm NB each)		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 29 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनडीपीसी NTPC
	(1-B)- CLARIFIED (RO PERMEATE)/ACW WATER STORAGE TANK		
	No	Description	Parameters/ Data
		b) Pump(s) re-circulation headers	4 (300, 250, 200 & 100 mm NB each)
		c) Additional filling connection	Two (300 & 200 mm NB size)
	(1-C-1)- RO (Reverses Osmosis-2nd Stage) Plant		
	No	Description	Parameters/ Data
	1-C-1) <u>General</u>		
	1)	Feed Water source	Permeate from SWRO.
	2)	Net output from 2 nd stage RO Plant at design condition with all the trains in operation.	450 Cum/hr
	3)	Guaranteed Recovery (design)	85%
	4)	Design Water Temperature range	25 - 32 deg C
	5)	Design Inlet Water quality	Permeate Water as received from SWRO(1st Stage) Plant
	6)	Design Effluent water quality (Total Dissolved Solids)	350 ppm
	1-C-2) <u>RO Trains /Streams (2nd Stage)</u>		
	1)	Number (Working + Standby) of trains	Three (3) (2 W+ 1 S)
2)	Turn Down Capability	One or both the trains shall be operable as per requirement	
3)	Design Net Capacity of each Train (Permeate flow)	225 Cum/hr.	
4)	Gross Capacity of each Train	225 Cum/hr + internal consumption of RO system + chemical preparation requirements + any other system requirement considered by Bidder	
5)	Membrane Assembly Unit(Block)		
	a. Number of Membrane (Block) per Train	One or more as per design	
	b. Number of Membranes per module	7 - 8	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 30 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	No	Description	Parameters/ Data
		c. Guaranteed Design Recovery	Not less than 85%
		d. Module	
		i. Internal Diameter	As per manufacturer
		ii. Length	As per manufacturer to suit the element
		e. Elements	
		i. Membrane type	Polyamide, Spiral wound
		ii. Diameter	Standard diameter as per manufacturer
		iii. Length	Standard diameter as per manufacturer
		iv. Average Flux	25 L/M²h
		v. Fouling Allowance for design	Minimum 5% per year
		vi. Salt passage increase	Minimum 10% per year
	5)	Other Technical Requirements	Refer sub-section titled “Reverse Osmosis System” in Part-B of Technical Specification
	6)	Handling Equipments for Membrane Assembly	Refer CI No-10.03.00 (vii) Subsection –III-A4 of Technical Specification
	1-C-3) 7)	High Pressure Pump (2nd stage RO Unit)	
	1)	Purpose	To pump permeate water at the downstream of SWRO upto the ACW tank thru Cartridge filter 2nd stage RO trains.
	2)	Number of pumps	One per RO train
	3)	Type of Pumps	Single/ Multistage Horizontal Centrifugal
	4)	Design flow rate of each Pump	To suit the Gross capacity of each RO train
	5)	Rated Head	1.10 x (RO train Feed Pressure + frictional loss in piping)
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
			PAGE 31 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	No	Description	Parameters/ Data	
	6)	Maximum pump operating speed	1500 rpm	
	7)	Pumps and drives to be designed for	Under Shed	
	8)	Service Duty	Continuous	
	9)	Type of pump casing	As per manufacturer's standard	
	10)	Type of impeller	Closed / Semi-open	
	11)	Type of lubrication	Grease	
	12)	Suction condition	Flooded	
	13)	Type of Shaft Sealing	Mechanical Seal	
	14)	Type of coupling (motor& pump)	As per manufacturer's standard	
	15)	Material of Construction		
		a) Casing	ASTM A351, CF8M	
		b) Impeller	ASTM A351, CF8M	
		c) Shaft	SS-316	
		d) Shaft sleeves	SS – 410	
		e) Mechanical Seal	As per manufacturer's standard suiting to the liquid being pumped	
		f) Wear rings	SS -316	
		g) Sleeves	ASTM A451, grade CPF8M or equivalent	
		h) Bolting	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel.	
		i) Base plate	Carbon steel/ Cast Iron	
	16)	Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc,	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 32 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	No	Description	Parameters/ Data	
			b) Coupling guards, Eye bolts, lifting etc.	
	17)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" & sub-section titled "Reverse Osmosis System" in Part-B of Technical Specification	
	18)	Handling Equipments for Pumps	Refer CI No-10.03.00 (vii) Subsection –III-A4 of Technical Specification	
	1-C-4) Cartridge Filtration Units (for 2nd Stage RO units)			
	1)	Fluid Handled	Permeate of 1 st Stage SWRO units delivered by RO (2 nd Stage) Plant feed pumps	
	2)	Type of Filtration unit	Horizontal / Vertical type;	
	3)	Numbers (Working + Standby)	Three (3) (2 W+ 1 S)	
	4)	Filtration Capacity of each Filter	To suit the Gross capacity of each RO train	
	5)	Filtration Efficiency	95% down to 1 microns	
	6)	Material of Construction		
		a) Filter Element	Polypropylene (continuously wound)	
		b) Filter Casing & Internals	SS -316L	
	1-C-5) RO Plant HP Feed Pumps (for 2nd Stage RO units)			
	1)	Purpose	To pump permeate of 1 st Stage SWRO Plant thru Cartridge filtration units and 2 nd stage RO units upto ACW tank.	
	2)	Source of Water	Permeate water of 1st Stage SWRO Plant.	
	3)	Number of pumps	One per RO train; Total 3 numbers	
	4)	Type of Pumps	Horizontal Centrifugal	
	5)	Design flow rate of each Pump	To suit the Gross capacity of each RO train	
	6)	Rated Head of pump	1.1 x (Pressure drop across	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 33 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	No	Description	Parameters/ Data	
			Cartridge filters + frictional loss in piping, valves etc)	
	7)	Maximum pump operating speed	1500 rpm	
	8)	Pumps and drives to be designed for	Under Shed	
	9)	Service Duty	Continuous	
	10)	Type of pump casing	As per manufacturer's standard	
	11)	Type of impeller	Closed / Semi-open	
	12)	Type of lubrication	Grease	
	13)	Suction condition	Flooded	
	14)	Type of Shaft Sealing	Gland Packing or Mechanical Seal	
	15)	Type of coupling (motor& pump)	As per manufacturer's standard	
	16)	Material of Construction		
		a) Casing	SS-316L	
		b) Impeller	SS-316L	
		c) Shaft	SS-316L	
		d) Shaft sleeves	SS – 410	
		e) Gland & Packing	Impregnated TEFLON	
		f) Mechanical Seal (if used)	As per manufacturer's standard suiting to the liquid being pumped	
		g) Wear rings	SS -316L	
		h) Bolting	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel.	
		i) Base plate	Carbon steel/ Cast Iron	
	17)	Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 34 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	No	Description	Parameters/ Data	
			lubrication system upto and including isolating valve etc, b) Coupling guards, Eye bolts, lifting etc.	
	18)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" in Part-B of Technical Specification	
	19)	Handling Equipments for Pumps	Refer CI No-10.03.00 (vii) Subsection –III-A4 of Technical Specification.	
	1-C-6)	Chemical Cleaning System (for 2nd Stage RO Plant)		
	1)	Chemical Tanks		
		a) Numbers Required	Two (2)	
		b) Effective Capacity of both the tanks	Total Piping + Volume of one RO Train	
		c) Material of Construction	FRP or Mild steel 4.5 mm thick rubber lined	
		d) Accessories	One mixer per tank; Motor driven with reduction gear unit ; Chemical Filling, Overflow & drain Connections with valves	
	2)	Chemical Cleaning Pumps		
		a) Numbers Required (Working + Standby)	Two (2) (1 W +! S)	
		b) Type	Horizontal Centrifugal	
		c) Design flow rate of each Pump	Suitable for cleaning of one RO train/stream at a time	
		d) Rated Head of pump	As required	
		e) Material of Construction of wetted parts	As per proven practice of RO plant supplier	
	3)	Cartridge filters (for chemical cleaning)		
		a) Numbers Required (Working + Standby)	Two (2) (1 W + 1 S)	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 35 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC
	No	Description	Parameters/ Data
		b) Capacity of each filter	To suit chemical cleaning pump capacity
		c) Filtering Efficiency	90% down to 5 microns
		d) Filter Element	Polypropylene wound filament
		e) Material of Filter Casing	MSRL/ GRP / FRP
	3-C-7) Flushing System		
	1) Flushing Pumps		
		a) Numbers Required (Working + Standby)	Two (2) (1 W + 1 S)
		b) Type	Horizontal Centrifugal
		c) Design flow rate of each Pump	Suitable for cleaning of one RO train/stream at a time
		d) Rated Head of pump	As Required
		e) Material of Construction	As per proven practice of RO plant supplier
	3-C-8) Suck-Back arrangement (If applicable)		
		Number	One Complete Set
		Capacity of tank	Suitable for three RO trains
		Material of construction	Mild Steel Rubber lined or FRP
		Accessories	Piping, Valves, Check valves instruments etc.
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
			PAGE 36 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC																																																												
	2) SWRO (Sea Water Reverse Osmosis) SYSTEM 2-A)- SWRO (REVERSES OSMOSIS) PLANT (1ST STAGE) (2-A-1)- 1st RO PERMEATE WATER STORAGE TANK <table><tr><th>No</th><th>Description</th><th>Parameters/ Data</th></tr><tr><td>17)</td><td>Fluid to be Stored</td><td>Permeate water produced from 1st RO Plant</td></tr><tr><td>18)</td><td>Type of Tanks</td><td>Vertical Cylindrical Atmospheric</td></tr><tr><td>19)</td><td>Design Standard</td><td>IS :803</td></tr><tr><td>20)</td><td>Size of Tank</td><td>6 m (diameter) x 5.4 m (Ht)</td></tr><tr><td>21)</td><td>Numbers required</td><td>One (1)</td></tr><tr><td>22)</td><td>Location</td><td>Outdoor</td></tr><tr><td>23)</td><td>Shell material</td><td>Mild Steel as per specified code</td></tr><tr><td>24)</td><td>Shell thickness (minimum)</td><td>As per IS : 803</td></tr><tr><td>25)</td><td>Bottom Plate Thickness (minimum)</td><td>10 mm</td></tr><tr><td>26)</td><td>Roof Plate Thickness (minimum)</td><td>6 mm</td></tr><tr><td>27)</td><td>Internal Protection</td><td>Solvent free epoxy coating</td></tr><tr><td>28)</td><td>Manhole</td><td>Minimum 2 numbers (one on the shell and other on the roof)</td></tr><tr><td>29)</td><td>Accessories</td><td>a) Stair-case & platform b) Vent, Overflow and drain connections c) Overflow seal d)Hand railing on the roof of the tank all around the tank</td></tr><tr><td>30)</td><td>Design Drawl rate from the Tank</td><td>150 Cum/hr</td></tr><tr><td>31)</td><td>Filling connection Size</td><td>To be decided by Bidder.</td></tr><tr><td>32)</td><td colspan="2">Additional nozzle connections for Employer (<i>indicative sizes</i> are given below; Actual Size shall be decided during detailed engineering - Spare connections shall be provided with blind flange)</td></tr><tr><td></td><td>a) To Suction Header</td><td>2 (500 mm NB & 300 mm NB each)</td></tr><tr><td></td><td>b) Pump(s) re-circulation headers</td><td>4 (300, 250, 200 & 100 mm NB each)</td></tr><tr><td></td><td>c) Additional filling connection</td><td>Two (300 & 200 mm NB size)</td></tr></table>			No	Description	Parameters/ Data	17)	Fluid to be Stored	Permeate water produced from 1 st RO Plant	18)	Type of Tanks	Vertical Cylindrical Atmospheric	19)	Design Standard	IS :803	20)	Size of Tank	6 m (diameter) x 5.4 m (Ht)	21)	Numbers required	One (1)	22)	Location	Outdoor	23)	Shell material	Mild Steel as per specified code	24)	Shell thickness (minimum)	As per IS : 803	25)	Bottom Plate Thickness (minimum)	10 mm	26)	Roof Plate Thickness (minimum)	6 mm	27)	Internal Protection	Solvent free epoxy coating	28)	Manhole	Minimum 2 numbers (one on the shell and other on the roof)	29)	Accessories	a) Stair-case & platform b) Vent, Overflow and drain connections c) Overflow seal d)Hand railing on the roof of the tank all around the tank	30)	Design Drawl rate from the Tank	150 Cum/hr	31)	Filling connection Size	To be decided by Bidder.	32)	Additional nozzle connections for Employer (<i>indicative sizes</i> are given below; Actual Size shall be decided during detailed engineering - Spare connections shall be provided with blind flange)			a) To Suction Header	2 (500 mm NB & 300 mm NB each)		b) Pump(s) re-circulation headers	4 (300, 250, 200 & 100 mm NB each)		c) Additional filling connection	Two (300 & 200 mm NB size)
No	Description	Parameters/ Data																																																													
17)	Fluid to be Stored	Permeate water produced from 1 st RO Plant																																																													
18)	Type of Tanks	Vertical Cylindrical Atmospheric																																																													
19)	Design Standard	IS :803																																																													
20)	Size of Tank	6 m (diameter) x 5.4 m (Ht)																																																													
21)	Numbers required	One (1)																																																													
22)	Location	Outdoor																																																													
23)	Shell material	Mild Steel as per specified code																																																													
24)	Shell thickness (minimum)	As per IS : 803																																																													
25)	Bottom Plate Thickness (minimum)	10 mm																																																													
26)	Roof Plate Thickness (minimum)	6 mm																																																													
27)	Internal Protection	Solvent free epoxy coating																																																													
28)	Manhole	Minimum 2 numbers (one on the shell and other on the roof)																																																													
29)	Accessories	a) Stair-case & platform b) Vent, Overflow and drain connections c) Overflow seal d)Hand railing on the roof of the tank all around the tank																																																													
30)	Design Drawl rate from the Tank	150 Cum/hr																																																													
31)	Filling connection Size	To be decided by Bidder.																																																													
32)	Additional nozzle connections for Employer (<i>indicative sizes</i> are given below; Actual Size shall be decided during detailed engineering - Spare connections shall be provided with blind flange)																																																														
	a) To Suction Header	2 (500 mm NB & 300 mm NB each)																																																													
	b) Pump(s) re-circulation headers	4 (300, 250, 200 & 100 mm NB each)																																																													
	c) Additional filling connection	Two (300 & 200 mm NB size)																																																													
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 37 OF 88																																																												

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	2-A-2) Permeate transfer pumps (1st stage RO Unit)		
19)	Purpose	To pump permeate water at the downstream of SWRO upto the 2 nd stage RO HP feed pump thru Cartridge filter of 2 nd stage RO trains.	
20)	Number of pumps	One per 2 nd RO train	
21)	Type of Pumps	Single/ Multistage Horizontal Centrifugal	
22)	Design flow rate of each Pump	To suit the Gross capacity of each 2 nd stage RO HP feed pump+ any other internal loss	
23)	Rated Head	1.10 x (2 nd RO Cartridge filter pressure loss + frictional loss in piping)	
24)	Maximum pump operating speed	1500 rpm	
25)	Pumps and drives to be designed for	Under Shed	
26)	Service Duty	Continuous	
27)	Type of pump casing	As per manufacturer's standard	
28)	Type of impeller	Closed / Semi-open	
29)	Type of lubrication	Grease	
30)	Suction condition	Flooded	
31)	Type of Shaft Sealing	Mechanical Seal	
32)	Type of coupling (motor& pump)	As per manufacturer's standard	
33)	Material of Construction		
	a) Casing	ASTM A351, CF8M	
	b) Impeller	ASTM A351, CF8M	
	c) Shaft	SS-316	
	d) Shaft sleeves	SS – 410	
	e) Mechanical Seal	As per manufacturer's standard suiting to the liquid being pumped	
	f) Wear rings	SS -316	
	g) Sleeves	ASTM A451, grade CPF8M or	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 38 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																													
	h) Bolting i) Base plate 34) Accessories to be provided with each pump 35) Other Technical Requirements 36) Handling Equipments for Pumps 2-A-3) 1ST STAGE RO PLANT <table><thead><tr><th>No</th><th>Description</th><th>Parameters/ Data</th></tr></thead><tbody><tr><td>1)</td><td>Feed Water source</td><td>Filtered sea water from PT Plant - From the discharge of HP-SWRO (1st Stage) Feed pumps</td></tr><tr><td>2)</td><td>Treated permeate</td><td>To HP-SWRO (2nd Stage) Feed pumps</td></tr><tr><td>3)</td><td>Net output from SWRO (1st Stage) Plant at design conditions with all the working trains under operation.</td><td>Designated flow as required by the downstream process equipment Minimum 550 m³/hr</td></tr><tr><td>4)</td><td>Guaranteed Recovery – Design</td><td>35%</td></tr><tr><td>5)</td><td>Design Water Temperature range</td><td>25 -32 deg C</td></tr><tr><td>6)</td><td>Design Inlet sea Water quality</td><td>Refer Sub-section-II-A8 of Part-A of Technical Specification</td></tr><tr><td>7)</td><td>Design Effluent water quality (TDS Value)</td><td>As required to meet the 2nd stage RO outlet TDS Less than 350 ppm</td></tr><tr><td>8)</td><td></td><td></td></tr></tbody></table>	No	Description	Parameters/ Data	1)	Feed Water source	Filtered sea water from PT Plant - From the discharge of HP-SWRO (1 st Stage) Feed pumps	2)	Treated permeate	To HP-SWRO (2 nd Stage) Feed pumps	3)	Net output from SWRO (1 st Stage) Plant at design conditions with all the working trains under operation.	Designated flow as required by the downstream process equipment Minimum 550 m ³ /hr	4)	Guaranteed Recovery – Design	35%	5)	Design Water Temperature range	25 -32 deg C	6)	Design Inlet sea Water quality	Refer Sub-section-II-A8 of Part-A of Technical Specification	7)	Design Effluent water quality (TDS Value)	As required to meet the 2 nd stage RO outlet TDS Less than 350 ppm	8)			equivalent Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel. Carbon steel/ Cast Iron c) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, d) Coupling guards, Eye bolts, lifting etc. Refer sub-section titled “Horizontal Pumps” & sub-section titled “Reverse Osmosis System” in Part-B of Technical Specification Refer CI No-10.03.00 (vii) Subsection –III-A4 of Technical Specification	
No	Description	Parameters/ Data																												
1)	Feed Water source	Filtered sea water from PT Plant - From the discharge of HP-SWRO (1 st Stage) Feed pumps																												
2)	Treated permeate	To HP-SWRO (2 nd Stage) Feed pumps																												
3)	Net output from SWRO (1 st Stage) Plant at design conditions with all the working trains under operation.	Designated flow as required by the downstream process equipment Minimum 550 m ³ /hr																												
4)	Guaranteed Recovery – Design	35%																												
5)	Design Water Temperature range	25 -32 deg C																												
6)	Design Inlet sea Water quality	Refer Sub-section-II-A8 of Part-A of Technical Specification																												
7)	Design Effluent water quality (TDS Value)	As required to meet the 2 nd stage RO outlet TDS Less than 350 ppm																												
8)																														
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 39 OF 88																											

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	2-A-4) <u>SWRO Train</u> 1) Number (Working + Standby) of SWRO trains Three (3); (2W+1S) 2) Turn Down Capability One, two or all the SWRO trains shall be operable as per requirement 3) Design Net Capacity of each Train (Permeate flow) Designated flow as required by the downstream process equipment Minimum 275 m³/hr 4) Gross Capacity of each Train To suit system requirement i.e. SWRO Permeate Flow (Net) + internal consumption of SWRO system + chemical preparation requirements + any other system requirement considered by Bidder 5) Membrane Assembly Unit(Block) a) Number of Membrane (Block) per Train One or more as per design b) Number of Membranes per module 7-8 (Maximum/ Minimum) c) Guaranteed Design Recovery 35% d) Module i) Internal Diameter As per manufacturer ii) Length As per manufacturer to suit the element e) Elements i. Membrane type Polyamide, Spiral wound suitable for Sea water ii. Diameter Standard diameter as per manufacturer iii. Length Standard diameter as per manufacturer iv. Average Flux 14 L/M²h v. Fouling Allowance for design Minimum 10% per year vi. Salt passage increase Minimum 15% per year 6) Other Technical Requirements Refer sub-section-I-M5 titled "Reverse Osmosis System" in Part-B of Technical Specification		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 40 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	7)	Handling Equipments for Pumps	Refer Subsection –I-M5 of Part-B of Technical Specification	
	2-A-5)	High Pressure Feed Pumps (SWRO Unit)		
	1)	Purpose	To pump filtered sea water at the downstream of Cartridge filters upto the 2 nd stage RO feed pump thru SWRO(1 st Stage) trains/streams	
	2)	Number of Pumps	One per SWRO train & ; Total three(3) Nos	
	3)	Type of Pumps	Multistage Horizontal Centrifugal	
	4)	Design flow rate of each Pump	To suit Gross capacity of each SWRO train & Guaranteed design Recovery of SWRO train	
	5)	Rated Head of pump	1.1 x (SWRO train Feed Pressure + frictional loss in piping, valves, fittings etc)	
	6)	Maximum pump operating speed	3000 rpm	
	7)	Pumps and drives to be designed for	Under Shed	
	8)	Service Duty	Continuous	
	9)	Density of Sea water (for design)	1030 Kg/Cum	
	10)	Type of pump casing	As per manufacturer's standard	
	11)	Type of impeller	Closed / Semi-open	
	12)	Type of lubrication	Grease	
	13)	Suction condition	Flooded	
	14)	Type of Shaft Sealing	Mechanical Seal	
	15)	Type of coupling (motor& pump)	As per manufacturer's standard	
	16)	Material of Construction	Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40	
	a)	Casing & Impeller	ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent	
			(Refer Note * above)	
	b)	Shaft & Shaft Sleeves	ASTM A 473 S3260 or Equivalent	
	c)	Mechanical Seal / Gland	ASTM 890 Gr 5A / ASTM 995 Gr 5A /	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 41 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
		ASTM A 312 S31254 / Equivalent / Duplex Stainless Steel	
	d) Wearing rings		
	e) Bolts, nuts etc	Wetted - Duplex Stainless Steel	
	f) Base Plate	Carbon steel with coating against corrosion of sea water	
	17) Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Coupling guards, Eye bolts, lifting etc.	
	18) Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" & sub-section titled "Reverse Osmosis System" in Part-B of Technical Specification.	
	19) Handling Equipments for Pumps	Refer Subsection –I-M5 of Part-B of Technical Specification	
	20) Energy (ERU) Recovery Units		
	a) Type of ERU	Turbo chargers or Pressure (PX) Exchangers,	
	b) <u>Numbers to be provided</u>		
	i) Turbo-chargers	One unit per High Pressure Feed pump Total three(3) numbers	
	ii) Pressure Exchangers	One array per SWRO Train	
	c) <u>Maximum Operating Speed</u>		
	i) Turbo-chargers	As per Manufacturer's std.	
	ii) Pressure Exchangers		
	d) Design Flow rate of each ERU	To match capacity of SWRO train	
	e) Rated Head of pump	Permeator outlet pressure + System losses upto inlet of ERU	
	f) Back Pressure	Required Head to discharge Brine water upto Brine Water Storage tank/Filter back wash storage tank	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 42 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	g) Number of Pumps One per SWRO train; one common standby, Total three(3) Nos h) Material of Construction Wetted parts :- ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN / ASTM A 473 S3260 / ASTM A 312 S31254 Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40 Others : SS 316 / SS - 317 Base Plats shall be Carbon steel with coating against corrosion of sea water i) PX Booster Pumps (applicable for PX type ERU) 1) Number of pumps One per SWRO train & one common standby ; Total Three (3) Nos 2) Type Multistage Horizontal Centrifugal 3) Design flow rare (Cum/hr) of each pump To suit PX unit Capacity 4) Rated Head of pump 1.1 x (RO feed module pressure + losses) 5) Material of Construction Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40 i) Casing & Impeller ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent (Refer Note * above) ii) Shaft & Shaft Sleeves ASTM A 473 S3260 or Equivalent iii) Mechanical Seal / Gland ASTM 890 Gr 5A / ASTM 995 Gr 5A / / ASTM A 312 S31254 / Equivalent iv) Wearing rings Duplex Stainless Steel v) Bolts, nuts etc Wetted - Duplex Stainless Steel ; Others – SS 316 / SS - 317 vi) Base Plate Carbon steel with coating against corrosion of sea water		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 43 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	j) Other Technical Requirements Refer sub-section titled “Horizontal Pumps” & sub-section titled “Reverse Osmosis System” in Part-B of Technical Specification. 2-A-6) Chemical Cleaning System (for 1st Stage SWRO Plant) 1) Chemical Tanks a) Numbers Required Two (2) b) Effective Capacity of both the tanks Requirement of Total Piping plus volume of one SWRO train c) Material of Construction FRP or Mild steel 4.5 mm thick rubber lined d) Accessories One mixer per tank; Motor driven with reduction gear unit ; Chemical Filling, Overflow & drain Connections with valves 2) Chemical Cleaning Pumps a) Numbers Required (Working + Standby) Two (2) (1 W + 1 S) b) Type Horizontal Centrifugal c) Design flow rate of each Pump Suitable for cleaning of one SWRO train /stream at a time d) Rated Head of pump As Required e) Material of Construction As per proven practice of SWRO plant supplier 3) Cartridge filters a) Numbers Required (Working + Standby) Two (2) (1 W +1 S) b) Capacity of each filter To suit chemical cleaning pump c) Filtering Efficiency 95% down to 5 microns d) Filter Element Polypropylene wound filament e) Material of Filter Casing MSRL/ GRP / FRP 2-A-7) Flushing System 1) Flushing Pumps a) Numbers Required (Working + Standby) Two (2) (1 W +1 S)		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 44 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC																																					
	b) Type Horizontal Centrifugal c) Design flow rate of each Pump Suitable for cleaning of one SWRO trains/streams at a time d) Rated Head of pump As Required e) Material of Construction As per proven practice of SWRO plant supplier 2-A-8) Suck-Back arrangement a) Number One Complete Set b) Capacity of tank To suit all the SWRO trains c) Material of construction Mild steel rubber lined or FRP d) Accessories Piping, Valves, Check valves instruments etc. 2-B) - BRINE WATER COLLECTION & DISPOSAL SYSTEM <table><tr><th>No</th><th>Description</th><th>Parameters/ Data</th></tr><tr><td>1)</td><td>System Description</td><td>Refer Subsection II of Part- A of Technical Specification</td></tr><tr><td>2)</td><td>Filter Back Wash Water Storage Tank</td><td></td></tr><tr><td>a)</td><td>Number</td><td>One</td></tr><tr><td>b)</td><td>Material of construction</td><td>RCC</td></tr><tr><td>c)</td><td>Type</td><td>Above ground</td></tr><tr><td>d)</td><td>Water collected</td><td>Reject water from SWRO (1st and 2nd Stage) Plant</td></tr><tr><td>e)</td><td>Effective Capacity of Tank</td><td>For holding water required for simultaneous backwashing of one Dual Media Filter and cartridge filter of Pre-treatment System.</td></tr><tr><td>3)</td><td>Brine Water Storage Tank</td><td></td></tr><tr><td>a)</td><td>Number</td><td>One in twin section</td></tr><tr><td>b)</td><td>Material of construction</td><td>RCC</td></tr><tr><td>c)</td><td>Type</td><td>Above ground</td></tr><tr><td>d)</td><td>Water collected from</td><td> a) Overflow from Filter Backwash water storage tanks. b) Backwash water from all the filters </td></tr></table>	No	Description	Parameters/ Data	1)	System Description	Refer Subsection II of Part- A of Technical Specification	2)	Filter Back Wash Water Storage Tank		a)	Number	One	b)	Material of construction	RCC	c)	Type	Above ground	d)	Water collected	Reject water from SWRO (1 st and 2 nd Stage) Plant	e)	Effective Capacity of Tank	For holding water required for simultaneous backwashing of one Dual Media Filter and cartridge filter of Pre-treatment System.	3)	Brine Water Storage Tank		a)	Number	One in twin section	b)	Material of construction	RCC	c)	Type	Above ground	d)	Water collected from	a) Overflow from Filter Backwash water storage tanks. b) Backwash water from all the filters
No	Description	Parameters/ Data																																						
1)	System Description	Refer Subsection II of Part- A of Technical Specification																																						
2)	Filter Back Wash Water Storage Tank																																							
a)	Number	One																																						
b)	Material of construction	RCC																																						
c)	Type	Above ground																																						
d)	Water collected	Reject water from SWRO (1 st and 2 nd Stage) Plant																																						
e)	Effective Capacity of Tank	For holding water required for simultaneous backwashing of one Dual Media Filter and cartridge filter of Pre-treatment System.																																						
3)	Brine Water Storage Tank																																							
a)	Number	One in twin section																																						
b)	Material of construction	RCC																																						
c)	Type	Above ground																																						
d)	Water collected from	a) Overflow from Filter Backwash water storage tanks. b) Backwash water from all the filters																																						
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 45 OF 88																																					

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	of PT System. c) Waste water from Chemical cleaning & Flushing system of UF & SWRO trains. d) Reject water from RO (2nd Stage) trains e) Chemical drains from Chemical Handling & dosing system f) Drains from any others tanks /pressure vessels handling sea water. g) Sludge from Clarifier e) Effective Capacity of Tank 400 Cum (minimum) f) Arrangement for chemical neutralization before disposal Required; Dosing of Acid (50 lit) & lime dosing pots (500 lit) by gravity. g) Agitation system for waste water Thru pump recirculation 4) Waste Disposal Pumps a) Purpose To pump waste water from Desalination Plant from Brine Water storage tank to the Employer's final effluent disposal pipe(to Central Monitoring basin). b) Density of brine (for design) 1050 Kg/Cum c) Type of pumps Horizontal Centrifugal d) Number of Pumps(Working+ Standby) Two (2) (1 W + 1 S) e) Design flow (Cum/hr) rate of each pump 1350 f) Rated Head of pump in mWC As per system requirement g) Maximum pump operating speed 1500 rpm h) Pumps and drives to be designed for Under Shed i) Service Duty Continuous j) Type of pump casing As per manufacturer's standard k) Type of impeller Closed / Semi-open		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 46 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC	
	l) Type of lubrication m) Suction condition n) Type of Shaft Sealing o) Type of coupling (motor& pump) p) Accessories to be provided with each pump q) Other Technical Requirements r) Handling Equipments for Pumps s) Material of Construction	Grease Flooded Mechanical Seal As per manufacturer’s standard a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Coupling guards, Eye bolts, lifting etc. Refer sub-section titled “Horizontal Pumps” in Part-B of Technical Specification Refer Subsection –I-M5 of Part-B of Technical Specification Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40 a) Casing & Impeller ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent (Refer Note * above) b) Shaft & Shaft Sleeves ASTM A 473 S3260 or Equivalent c) Mechanical Seal / Gland ASTM 890 Gr 5A / ASTM 995 Gr 5A / / ASTM A 312 S31254 / Equivalent d) Wearing rings Duplex Stainless Steel e) Bols, nuts etc Wetted - Duplex Stainless Steel ; Others – SS 316 / SS - 317 f) Base Plate Carbon steel with coating against corrosion of sea water		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 47 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC	
	3) ULTRAFILTRATION (UF) (FOR SWRO UNITS)			
	3-A-1 SELF CLEANING STRAINER (SCS)			
	No	Description	Parameters/ Data	
	1)	Fluid Handled	Filtered sea water delivered by Dual Media Filters of PT System	
	2)-a	Design Capacity of SCS (Gross)	To suit system requirement	
	2)-b	Cleaning provision	Automatic self-cleaning	
	3)	Material of Construction	Suitable for sea water application.	
	3-A-2 ULTRAFILTRATION (UF) PLANT			
	No	Description	Parameters/ Data	
	1)	Fluid Handled	Filtered sea water delivered by Dual Media Filters of PT System	
	2)-a	Design Capacity of UF (Gross)	To suit system requirement i.e. UF Permeate Flow (Net) + water required for backwashing of UF membrane + chemical preparation requirements + any other system requirement considered by Bidder	
	2)-b	UF Permeate Flow (Net)	Total Design Flow of all working High Pressure Feed Pumps SWRO Unit) {Not less than 1700}m³/hr	
	4)	Recovery from UF	Not less than 92%	
	5)	Backwash provision	Automatic Backwash	
	6)	Type of Membrane	Pressurized Hollow Fiber	
	7)	Type of membrane mounting	Vertical	
	8)	Design permeate water quality	Turbidity < 1.0 NTU, SDI < 2 for 100% of time.	
	3-B-1 UF SEA WATER PERMEATE WATER TANK			
	No	Description	Parameters/ Data	
			UF (PERMEATE) WATER STORAGE TANKS	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 48 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC
	No	Description	Parameters/ Data
	1)	Fluid to be Stored	Permeate Water produced from Ultrafiltration Plant
	2)	Type of Tanks	One no of UF permeate storage tank of RCC construction with corrosion protection
	3)	Manhole	Minimum 2 numbers
	4)	Accessories	a) Stair case & platform b) Vent, drain, overflow connections c) Overflow seal d) Hand railing on roof of tank all around
	5)	Filling connection Size	To suit the system requirement
	6)	Nozzle connections	
		a) To Suction Header	To suit the system requirement
		b) Pump(s) re-circulation header	To suit the system requirement
		c) Additional suction connections for each tank	2 (300 & 200 NB)
		c) Additional filling connections for each tank	2 (200 & 150 NB)
	3-C-1 UF FEED PUMP, UF PERMEATE WATER TRANSFER PUMP, UF BACK WASH PUMPS		
	No	Description	Parameters/ Data
	1)	Type of pumps	Horizontal Centrifugal
	2)	Type of fluid	Sea water
	3)	Design flow (m³/hr) rate of each pump	Designated flow as required by the downstream process equipment
	4)	Rated Head of pump in MWC	As required
	5)	Service Duty	Continuous
	6)	Type of pump casing	As per manufacturer's standard
	7)	Type of impeller	Closed / Semi-open
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
		PAGE 49 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC
	No	Description	Parameters/ Data
	8)	<u>Material of Construction</u>	Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40 ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent (Refer Note * above) ASTM A 473 S32760 or Equivalent
		a) Casing & Impeller	ASTM 890 Gr 5A / ASTM 995 Gr 5A / ASTM A 312 S31254 / Equivalent.
		b) Shaft & Shaft Sleeves	Duplex Stainless Steel
		c) Mechanical Seal / Gland	Duplex Stainless Steel
		d) Wearing rings	
		e) Bolts, nuts etc.	
	4) PRE-TREATMENT SYSTEM		
	4-A) Cartridge Filtration Units (for 1 st SWRO units)		
	No	Description	Parameters/ Data
	1)	Fluid Handled	Filtered sea water delivered by Dual Media Filters of PT System
	2)	Type of Filtration unit	Horizontal / Vertical type;
	3)	Numbers (Working + Standby)	N+2
	4)	Design Capacity of Filters	Capacity of N+2 filters to match with the Design Capacity of UF (Gross) However performance shall not deteriorate while N filters in operation and two filter under Standby/Backwash mode
	5)	Filtration Efficiency	95% down to 1 microns
	6)	Material of Construction	
		a) Filter Element	Polypropylene (continuously wound)
		b) Filter Casing & Internals	MS– Rubber lined / MS-Polyurethane lined. ; Internals lined suiting to high pressure sea water
	4-B) Dual Media (DMF) Filters (for 1 st SWRO units)		
	No	Description	Parameters/ Data
	1)	Fluid Handled	Clarified sea water
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM			
PAGE 50 OF 88			

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	4-B) Dual Media (DMF) Filters (for 1st SWRO units)			
	No	Description	Parameters/ Data	
	2)	Type of Filtration unit	Horizontal cylindrical pressure vessel with dished (Torispherical type) ends ; Twin flow (section) type	
	3)	Numbers (Working + Standby)	N+2 However performance shall not deteriorate while N filters in operation and two filter under Standby/Backwash mode	
	4)	Design Capacity of Filters	Capacity of N+2 filters to match Designated flow as required by the downstream process equipment	
	5)	Backwash provision	Required: By reject water from SWRO train	
	6)	Period between two successive Backwashes	24 hours (minimum)	
	7)	Number of filters to be backwashed at a time	One (1)	
	8)	Material of Construction	Carbon Steel	
	9)	Internal Lining	Rubber Lining with 4.5 mm thick / Polyurethane lining (2 mm)	
	10)	Number of Manhole per Vessel	Minimum Two (2)	
	11)	No of Sight windows with minimum 75 mm clear width	Minimum Two (2)	
	12)	Water Distribution and Collection System	As per manufacturer's proven practice	
	4-C) Filter Back Wash Water Pumps			
	No	Description	Parameters/ Data	
	1)	Purpose	For Backwashing of filters	
	2)	Type of pumps	Horizontal Centrifugal	
	3)	Number of Pumps(Working+ Standby)		
	In case Backwash requirement of each type of filter is different	Two (1 W + 1 S) for backwashing of Dual Media Filters		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 51 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC		
	4-C) Filter Back Wash Water Pumps				
	No	Description	Parameters/ Data		
	4)	Design flow (Cum/hr) rate of each pump a) In case Backwash requirement of each type of filter is different	Capacity of respective pump shall be suitable for backwashing of one (both the sections) number filter		
	5)	Density of backwash water (for design)	1050 Kg/Cum		
	6)	Rated Head of pump in mWC	As required		
	7)	Maximum pump operating speed	1500 rpm		
	8)	Pumps and drives to be designed for	Under Shed		
	9)	Service Duty	Continuous		
	10)	Type of pump casing	As per manufacturer's standard		
	11)	Type of impeller	Closed / Semi-open		
	12)	Type of lubrication	Grease		
	13)	Suction condition	Flooded		
	14)	Type of Shaft Sealing	Mechanical Seal		
	15)	Type of coupling (motor& pump)	As per manufacturer's standard		
	16)	Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Coupling guards, Eye bolts, lifting etc.		
	17)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" in Part-B of Technical Specification		
	18)	Handling Equipments for Pumps	Refer Subsection –I-M5 of Part-B of Technical Specification		
	19)	Material of Construction	Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40		
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 52 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एन टी पी सी NTPC	
	4-C) Filter Back Wash Water Pumps			
	No	Description	Parameters/ Data	
	a)	Casing & Impeller	ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent (Refer Note * above)	
	b)	Shaft & Shaft Sleeves	ASTM A 473 S3260 or Equivalent	
	c)	Mechanical Seal / Gland	ASTM 890 Gr 5A / ASTM 995 Gr 5A / / ASTM A 312 S31254 / Equivalent	
	d)	Wearing rings	Duplex Stainless Steel	
	e)	Bols, nuts etc	Wetted - Duplex Stainless Steel ; Others – SS 316 / SS - 317	
	f)	Base Plate	Carbon steel with coating against corrosion of sea water	
	4-D) Filter Blowers (Air Scouring)			
	No	Description	Parameters/ Data	
	1)	Type	Twin lobe type	
	2)	Numbers (Working + Standby) required		
		In case scouring rate requirement of each type of filter is different	Two (1 W + 1 S) for Air scouring of Dual Media Filters	
	3)	Capacity of each blower		
		In case Air scouring requirement of each type of filter is different	Capacity of respective blower shall be suitable for air scouring of one (both the sections) number filter	
	4)	Discharge Pressure	As Required	
	5)	Material of Construction	As per manufacturer's. Standard	
6)	Accessories required	Suction filler, silencers, safety valve, sound proof housing, check valve, Base frame, anti-vibratory Panels, Belt guard etc		
4-E) Filter Feed Pumps				
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 53 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	No	Description	Parameters/ Data
	1)	Purpose	To pump Clarified Sea Water from Clarified sea Water storage tanks thru filters (DMF, self-cleaning strainer & Cartridge) upto suction header of UF-Feed Pumps
	2)	Type of pumps	Horizontal Centrifugal
	3)	Number of Pumps	Two(W) + One(S)
	4)	Total Design flow rate of working Pumps	Designated flow as required by the downstream process equipment
	5)	Density of water (for design)	1030 Kg/Cum
	6)	Rated head of pump in mWC	As required
	7)	Maximum pump operating speed	1500 rpm
	8)	Pumps and drives to be designed for	Under Shed
	9)	Service Duty	Continuous
	10)	Type of pump casing	As per manufacturer's standard
	11)	Type of impeller	Closed / Semi-open
	12)	Type of lubrication	Grease
	13)	Suction condition	Flooded
	14)	Type of Shaft Sealing	Mechanical Seal
	15)	Type of coupling (motor& pump)	As per manufacturer's standard
	16)	Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc, b) Coupling guards, Eye bolts, lifting etc.
	17)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" in Part-B of Technical Specification
	18)	Handling Equipments for Pumps	Refer Subsection –I-M5 of Part-B of Technical Specification
	19)	Material of Construction	Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40
		a) Casing & Impeller	ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 54 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
	4-E) Filter Feed Pumps				
	No	Description	Parameters/ Data (Refer Note * above)		
		b) Shaft & Shaft Sleeves	ASTM A 473 S3260 or Equivalent		
		c) Mechanical Seal / Gland	ASTM 890 Gr 5A / ASTM 995 Gr 5A / / ASTM A 312 S31254 / Equivalent		
		d) Wearing rings	Duplex Stainless Steel		
		e) Bols, nuts etc	Wetted - Duplex Stainless Steel ; Others – SS 316 / SS - 317		
		f) Base Plate	Carbon steel with coating against corrosion of sea water		
	4-F) Clarified Sea Water Storage Tank				
	No	Description	Parameters/ Data		
	1)	Number	One in twin section		
	2)	Material of construction	RCC		
	3)	Type	Above ground covered from top		
	4)	Water collected	Clarified Sea water from Clarifiers		
	5)	Effective Capacity of Tank	For holding 15 minutes of pumping rate from this tank		
	4-G) Clarifiers				
	No	Description	Parameters/ Data		
	1)	Number	Two (2)		
	2)	Type	Lamella type clarifier / Tube Settlers		
	3)	Design Flow rate of each Clarifier	125% of design flow of one Filter Feed pump (Minimum 1700 m³/hr)		
	4)	Material of construction of Tank	RCC		
	5)	Material of construction of internals	a) All steel parts shall be FRP lined b) Inclined Plates & Tube Packs shall be FRP/GRP		
	6)	Minimum Side Water Depth	4.0 m		
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 55 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC	
	4-G) Clarifiers			
	No	Description	Parameters/ Data	
	7)	Normal water level in Clarifier	Suitably designed so that sludge hopper is above ground to facilitate sludge draw-off to sludge collection (above ground) tank	
	8)	Other Technical Requirements	Refer sub-section titled “Clarifiers” in Part-B of Technical Specification	
	4-H) Flocculation Chamber			
	No	Description	Parameters/ Data	
	1)	Number	Two (2) ; One per Clarifier at the upstream of clarifier	
	2)	Design Flow rate of each Flocculation Chamber	Same as that of Clarifier	
	3)	Type	Circular or Rectangular in RCC Construction	
	4)	Number of Mixers per chamber	As per manufacturer’s practice	
	5)	Material of construction of Paddle of mixers	SS-316 L /FRP Lined MS/ Suitable for sea water	
	6)	Other Technical Requirements	Refer sub-section titled “Clarifiers” in Part-B of Technical Specification	
	4-I) Flash Mixer			
	No	Description	Parameters/ Data	
	1)	Number	Two (2) ; One per Clarifier at the upstream of flocculation chamber	
	2)	Design Flow rate of each Flocculation Chamber	Same as that of Clarifier	
	3)	Type	Circular or Rectangular in RCC Construction	
	4)	Material of construction of Paddle of mixers	SS-316 L /FRP Lined MS/ Suitable for sea water	
	5)	Other Technical Requirements	Refer sub-section titled “Clarifiers” in Part-B of Technical Specification	
	4-J) Stilling Chamber			
No	Description	Parameters/ Data		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 56 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	4-J)	Stilling Chamber	
	No	Description	Parameters/ Data
	1)	Number	One Common for all the Clarifiers at the upstream of Flash mixer
	2)	Design Flow rate	2x (Design flow rate of one Clarifier)
	3)	Type	Circular or Rectangular in RCC Construction
	4)	Other Technical Requirements	Refer sub-section titled “Clarifiers” in Part-B of Technical Specification
	4-K)	Sludge collection sump/ tank & pumps	
	No	Description	Parameters/ Data
	1)	Number	One Common for both the Clarifiers
	2)	Material of Construction	RCC
	3)	Effective capacity of tank/sump	250 Cu.M
	4)	Sludge Disposal Pumps	
		a) Number of sludge disposal pumps	Two (2) (1 Working + 1 Standby)
		b) Type of Pumps	Horizontal centrifugal type
		c) Design flow rate of each pump	150 Cum/hr
		d) Density of fluid (for design)	1030 Kg/Cum
		e) Rated Head of pump	As required
		f) Maximum pump operating speed	1500 rpm
		g) Pumps and drives to be designed for	Under Shed
		h) Service Duty	Continuous
		i) Type of pump casing	As per manufacturer’s standard
		j) Type of impeller	Open non – clog type
		k) Type of lubrication	Grease
		l) Suction condition	Flooded
		m)Type of Shaft Sealing	Mechanical Seal
	n) Type of coupling (motor& pump)	As per manufacturer’s standard	
	o) Accessories to be provided with each pump	a) Companion flanges with nuts, bolts and gaskets, Internal piping with	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM
			PAGE 57 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
	4-K) Sludge collection sump/ tank & pumps				
	No	Description	Parameters/ Data		
			valves filters & Instruments for sealing/ cooling/ lubrication system upto and including isolating valve etc,		
			b) Coupling guards, Eye bolts, lifting etc.		
	p)	Other Technical Requirements	Refer sub-section titled “Horizontal Pumps” in Part-B of Technical Specification		
	q)	Handling Equipments for Pumps	Refer Subsection –II & IIIA01of Part-A of Technical Specification		
	r)	Material of Construction	Note (*): Having PREN (Pitting Resistance Equivalent Number) greater than 40		
	1)	Casing & Impeller	ASTM 890 Gr 5A / ASTM 995 Gr 5A /ASTM 744 CN3MN or Equivalent (Refer Note * above)		
	2)	Shaft & Shaft Sleeves	ASTM A 473 S3260 or Equivalent		
	3)	Mechanical Seal / Gland	ASTM 890 Gr 5A / ASTM 995 Gr 5A / / ASTM A 312 S31254 / Equivalent		
	4)	Wearing rings	Duplex Stainless Steel		
	5)	Bols, nuts etc	Wetted - Duplex Stainless Steel ; Others – SS 316 / SS - 317		
	6)	Base Plate	Carbon steel with coating against corrosion of sea water		
	5) CHEMICAL STORAGE & DOSING SYSTEM				
	5-A) Coagulant Handling, Storage and Dosing System				
	5-A-1) Coagulant Unloading cum Transfer Pumps				
	No	Description	Parameters/ Data		
	1)	Purpose	To pump Coagulant from Tankers to Bulk Coagulant Storage Tanks and as well as to transfer Coagulant from Bulk Coagulant Storage Tanks to Coagulant Preparation tanks.		
	2)	Chemical to be used	Ferric Chloride of 35 – 45 % concentration		
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 58 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	5-A-1) Coagulant Unloading cum Transfer Pumps			
	No	Description	Parameters/ Data	
	3)	Type	Horizontal Centrifugal	
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)	
	5)	Duty	Intermittent	
	6)	Design flow rate of each pump	15 Cu.M/hr	
	7)	Rated Head of pump	As required	
	8)	Maximum Pump Speed	1500 rpm	
	9)	<u>Material of Construction</u>		
		a) Casing	FRP/ PP / CPVC	
		b) Impeller	FRP/ PP / CPVC	
		c) Shaft	As per manufacturer's standard	
		d) Shaft Sleeve	As per manufacturer's standard	
	10)	Type of Shaft Sealing	Mechanical Seal as per Mfr Std	
	11)	Sets of Hoses with coupling & Diaphragm type Isolation Valves		
		a) Number of Sets Required	Two (2)	
		b) Size of hose/ Valve	80 mm NB	
		c) Length of hoses	20 meters (minimum)	
		d) Material of hose	Chemical resistant, UV inhibited PVC	
	12)	Accessories Required for Pump	Coupling guard, drain plugs, vent valves etc	
13)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" in Part-B of Technical Specification		
5-A-2) Bulk Coagulant Storage & Preparation Tanks				
No	Description	Bulk Tanks	Preparation Tanks	
1)	Purpose	To store one month requirement of Coagulant	To prepare & store one day requirement of Coagulant	
2)	Chemical to handled	Ferric Chloride of 35–45% concentration	Ferric Chloride of 5 % concentration	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 59 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	5-A-1) Coagulant Unloading cum Transfer Pumps			
	No	Description	Parameters/ Data	
	3)	Number of tanks	Two (2)	Two (2)
	4)	Design Dosage rate	Minimum 15 ppm	
	5)	Design Quantity of Sea Water to be dosed	Total flow of three Clarifier Feed pumps	
	6)	Capacity of each tank	To store 15 days requirement	To hold 12 hours requirement
	7)	Type of Tank	Vertical(As per IS-803) or Horizontal atmospheric vessel(As per BS-2594) ; Covered	Vertical, atmospheric; Covered
	8)	Material of Construction	MSRL	MSRL/ FRP
	9)	Number of agitators	NA	One per tank
	10)	Shaft Material of Agitator	NA	SS 316 L / MS with FRP lining
	11)	Impeller Material of Agitator	NA	SS 316 L / MS with FRP lining
	12)	Accessories	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, platform, ladders etc as applicable	
	5-A-3) Coagulant Dosing Pumps			
	No	Description	Parameters/ Data	
	1)	Purpose	For dosing Coagulant solution in PT System	
	2)	Chemical to dosed	Ferric Chloride 5 % concentration	
	3)	Type	Simplex hydraulically operated Diaphragm type	
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)	
	5)	Duty	Continuous	
	6)	Design Quantity of Sea Water to be dosed	Total flow of two(2) Clarifier Feed pumps	
	7)	Design flow rate of each dosing pump	To suit minimum dosage rate of 15 ppm	
	8)	Rated Head of pump	As required	
	9)	Capacity control	0 --100% of capacity by micrometer dial	
10)	Pump stroke speed per minute	100 maximum		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 60 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	11)	Material of Construction		
	a)	Liquid end (pump head valve, valve housing, etc) ,valve spring	PP / FRP/CPVC	
	b)	Diaphragm	TEFLON	
	c)	Packing	As per manufacturer's Standard suiting to Chemical	
	d)	Shaft	As per manufacturer's Standard suiting to Chemical	
	12)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required	
	5-B) Coagulant – Aid Handling, Storage and Dosing System			
	5-B-1) Bulk Coagulant Aid Storage & Preparation Tanks			
	No	Description	Bulk Storage	Preparation Tanks
	1)	Purpose	To store one month requirement of Coagulant-aid	To prepare & store one day requirement of Coagulant –aid solution
	2)	Chemical to handled	Polyelectrolyte - As recommended by SWRO(1 st stage)/RO 2 nd stage plant - 100% Solution	Polyelectrolyte - As recommended by SWRO(1 st stage)/RO 2 nd stage plant - 5% Solution
	3)	Method of storage / Preparation	To be stored in the form of 50 Kg Carboys	In Tanks
	4)	Number of tanks	NA	Two (2)
	5)	Design Dosage rate	----- Minimum 2 ppm -----	
	6)	Design Quantity of Sea Water to be dosed	Total flow of two Clarifier feed pumps	
7)	Design Storage Capacity to be considered	To store 15 days requirement of the plant	Each tank to hold 12 hours requirement	
8)	Type of Tank	NA	Vertical, atmospheric; Covered	
9)	Material of Construction	NA	MSRL/ FRP	
10)	Agitator & Number	NA	One per tank	
11)	Agitator shaft Material	NA	SS 316 L / MS with FRP lining	
12)	Agitator Impeller Material	NA	SS 316 L / MS with FRP lining	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 61 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एन टी पी सी NTPC	
	5-B-1) Bulk Coagulant Aid Storage & Preparation Tanks				
	No	Description	Bulk Storage	Preparation Tanks	
	13)	Accessories	Two numbers of hand pumps for transferring chemical from carboys to preparation tanks	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, valves operating platform, ladders etc as applicable	
	5-B-2) Coagulant Aid Dosing Pumps				
	No	Description	Parameters/ Data		
	1)	Purpose	For dosing Coagulant aid solution in PT System		
	2)	Chemical to dosed	Polyelectrolyte solution of 5 % concentration		
	3)	Type	Simplex hydraulically operated Diaphragm type		
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)		
	5)	Duty	Continuous		
	6)	Design Quantity of Sea Water to be dosed	Total flow of Two(2) Clarifier		
	7)	Design flow rate of each dosing pump	To suit minimum dosage rate of 2 ppm		
	8)	Rated Head of pump	As required		
	9)	Capacity control	0 --100% of capacity by micrometer dial		
	10)	Pump stroke speed per minute	100 maximum		
	11)	Material of Construction			
		a) Liquid end (pump head valve, valve housing, etc) ,valve spring	PP / FRP/ CPVC		
		b) Diaphragm	TEFLON		
		c) Packing	As per manufacturer's Standard suiting to Chemical		
		d) Shaft	As per manufacturer's Standard suiting to Chemical		
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 62 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC	
	12)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required		
	5-C) Anti-Scalant Handling, Storage and Dosing System				
	5-C-1) Bulk Anti-Scalant Storage & Preparation Tanks				
	No	Description	Bulk Storage	Preparation Tanks	
	1)	Purpose	To store one month requirement of Anti-Scalant	To prepare & store one day requirement of Anti-Scalant solution	
	2)	Chemical to handled	Sodium Hexa Meta Phosphate (SHMP) - 100% Solution	Sodium Hexa Meta Phosphate (SHMP) - 5% Solution	
	3)	Method of storage / Preparation	To be stored in the form of 50 Kg Carboys	In Tanks	
	4)	Number of tanks	NA	Two (2)	
	5)	Design Dosage rate	----- Minimum 5 ppm -----		
	6)	Design Quantity of Sea Water to be dosed	Total flow of two numbers of SWRO-1st stage Plant Feed Pumps and two numbers of RO 2 nd stage) Plant Feed Pumps		
	7)	Design Storage Capacity to be considered	To store 15 days requirement of the plant	Each tank to hold 12 hours requirement	
	8)	Type of Tank	NA	Vertical, atmospheric; Covered	
	9)	Material of Construction	NA	MSRL/ FRP	
	10)	Agitator & Number	NA	One per tank	
	11)	Agitator shaft Material	NA	SS 316 L / MS with FRP lining	
	12)	Agitator Impeller Material	NA	SS 316 L / MS with FRP lining	
	13)	Accessories	Two numbers of hand pumps for transferring chemical from carboys to preparation tanks	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, valves operating platform, ladders etc as applicable	
	5-C-2) Anti-Scalant Dosing Pumps				
	No	Description	Parameters/ Data	Parameters/ Data	
	1)	Purpose	For dosing Anti-Scalant solution in SWRO(1 st Stage) System	For dosing Anti-Scalant solution in 2 nd stage RO	
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 63 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
	5-C-2) Anti-Scalant Dosing Pumps				
	No	Description	Parameters/ Data	Parameters/ Data system	
	2)	Chemical to dosed	Sodium Hexa Meta Phosphate solution of 5 % concentration	5	
	3)	Type	Simplex hydraulically operated Diaphragm type		
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)	Two (2) (1 W+ 1 S)	
	5)	Duty	Continuous		
	6)	Design Quantity of Sea Water to be dosed	Total flow of two SWRO(1 st Stage) Plant Feed pump	Total flow of two RO(2 nd Stage) Plant Feed pump	
	7)	Design flow rate of each dosing pump	To suit minimum dosage rate of 5 ppm		
	8)	Rated Head of pump	As required	As required	
	9)	Capacity control	0 --100% of capacity by micrometer dial		
	10)	Pump stroke speed per minute	100 maximum		
	11)	Material of Construction			
		a) Liquid end (pump head valve, valve housing, etc) ,valve spring	PP / FRP /CPVC		
		b) Diaphragm	TEFLON		
		c) Packing	As per manufacturer's Standard suiting to Chemical		
		d) Shaft	As per manufacturer's Standard suiting to Chemical		
	12)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required		
	5-D) Anti-Oxidant Handling, Storage and Dosing System				
	5-D-1) Bulk Anti-Oxidant Storage & Preparation Tanks				
	No	Description	Bulk Storage	Preparation Tanks	
	1)	Purpose	To store one month requirement of Anti-Oxidant	To prepare & store one day requirement of Anti-Oxidant solution	
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 64 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	5-D) Anti-Oxidant Handling, Storage and Dosing System			
	5-D-1) Bulk Anti-Oxidant Storage & Preparation Tanks			
	No	Description	Bulk Storage	Preparation Tanks
	2)	Chemical to handled	Sodium Meta bisulphite (SMBS) – 40-45% Solution	Sodium Meta bisulphite (SMBS) - 5% Solution
	3)	Method of storage / Preparation	To be stored in the form of 50 Kg Carboys	In Tanks
	4)	Number of tanks	NA	Two (2)
	5)	Design Dosage rate	----- Minimum 5 ppm -----	
	6)	Design Quantity of Sea Water to be dosed	Total flow of two numbers of SWRO-1st stage Plant Feed Pumps and two numbers of RO(2 nd stage) Plant Feed Pumps	
	7)	Design Storage Capacity to be considered	To store 15 days requirement of the plant	Each tank to hold 12 hours requirement
	8)	Type of Tank	NA	Vertical, atmospheric; Covered
	9)	Material of Construction	NA	MSRL/ FRP
	10)	Agitator & Number	NA	One per tank
	11)	Agitator shaft Material	NA	SS 316 L / MS with FRP lining
	12)	Agitator Impeller Material	NA	SS 316 L / MS with FRP lining
	13)	Accessories	Two numbers of hand pumps for transferring chemical from carboys to preparation tanks	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, valves operating platform, ladders etc as applicable
	5-D-2) Anti-Oxidant Dosing Pumps			
	No	Description	Parameters/ Data	Parameters/ Data
	1)	Purpose	For dosing Anti-oxidant solution in 1 st stage RO feed	For dosing Anti-oxidant solution in 2 nd stage RO feed
	2)	Chemical to dosed	Sodium Meta bisulphite solution of 5 % concentration	
	3)	Type	Simplex hydraulically operated Diaphragm type	
4)	Numbers required (Working	Two (2) (1 W+ 1 S)	Two (2) (1 W+ 1 S)	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 65 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एनटीपीसी NTPC
	5-D-2) Anti-Oxidant Dosing Pumps				
	No	Description	Parameters/ Data		
		+Standby)			
	5)	Duty	Continuous		
	6)	Design Quantity of Sea Water to be dosed	Total flow of two RO Plant Feed Pumps 1 st stage.	Total flow of two RO Plant Feed Pumps 2 nd stage.	
	7)	Design flow rate of each dosing pump	To suit minimum dosage rate of 5 ppm		
	8)	Rated Head of pump	As required	As required	
	9)	Capacity control	0 --100% of capacity by micrometer dial		
	10)	Pump stroke speed per minute	100 maximum		
	11)	Material of Construction			
	a)	Liquid end (pump head valve, valve housing, etc) ,valve spring	PP / FRP /CPVC		
	b)	Diaphragm	TEFLON		
	c)	Packing	As per manufacturer's Standard suiting to Chemical		
	d)	Shaft	As per manufacturer's Standard suiting to Chemical		
	12)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required		
	5-E) Acid Handling, Storage and Dosing System				
	5-E-1) Acid Unloading cum Transfer Pumps				
	No	Description	Parameters/ Data		
	1)	Purpose	To pump Acid from Tankers to Bulk Acid Storage Tanks and as well as to transfer Acid from Bulk Acid Storage Tanks to Acid Preparation & Measuring tanks		
	2)	Chemical to be used	Hydrochloric Acid - 30- 33% Concentration		
	3)	Type	Horizontal Centrifugal		
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 66 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एनटीपीसी NTPC
	5-E) Acid Handling, Storage and Dosing System				
	5-E-1) Acid Unloading cum Transfer Pumps				
	No	Description	Parameters/ Data		
	5)	Duty	Intermittent		
	6)	Design flow rate of each pump	15 Cu.M/hr		
	7)	Rated Head of pump	As required		
	8)	Maximum Pump Speed	1500 rpm		
	9)	<u>Material of Construction</u>			
		a) Casing	PP		
		b) Impeller	PP		
		c) Wearing Rings	As per manufacturer's standard		
		d) Shaft	PP / EN-8		
		e) Shaft Sleeve	PP/ As per manufacturer's standard		
	10)	Type of Shaft Sealing	Mechanical Seal as per Mfr Std		
	11)	Sets of Hoses with coupling & Diaphragm type Isolation Valves			
		a) Number of Sets Required	Two (2)		
		b) Size of hose/ Valve	80 mm NB		
		c) Length of hoses	20 meters (minimum)		
		d) Material of hose	Chemical resistant, UV inhibited PVC		
	12)	Accessories Required for Pump	Coupling guard, drain plugs, vent valves etc		
	13)	Other Technical Requirements	Refer sub-section titled "Horizontal Pumps" in Part-B of Technical Specification		
	5-E-2) Bulk Acid Storage & Preparation Tanks				
No	Description	Bulk Tanks	Measuring Tanks	Preparation Tanks	
1)	Chemical to be handled	Hydrochloric Acid of 30–33% concentration		Hydrochloric Acid of 5% concentration	
2)	Purpose	To store one month	To prepare &	To prepare &	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 67 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																																																
	 5-E) Acid Handling, Storage and Dosing System 5-E-1) Acid Unloading cum Transfer Pumps <table border="1"> <thead> <tr> <th>No</th><th>Description</th><th colspan="3">Parameters/ Data</th></tr> </thead> <tbody> <tr> <td></td><td></td><td>requirement of Acid</td><td>store acid for UF</td><td>store acid for one day requirement for pH control</td></tr> <tr> <td>3)</td><td>Number of tanks</td><td>Three (3)</td><td>Two (2)</td><td>Three (3)</td></tr> <tr> <td>4)</td><td>Design Dosage rate (Dosage rate indicated are minimum)</td><td>Total volume to be sized for dosing of 25 ppm in RO(1st & 2nd) (at the upstream of and Cartridge filters), plus dosage rate for UF</td><td>As recommended by UF provider</td><td>Total volume to be sized for dosing of 25 ppm in in RO(1st & 2nd) (at the upstream of and Cartridge filters),</td></tr> <tr> <td>5)</td><td>Design Quantity of Water to be dosed with acid for estimation of storage volume</td><td> a) For RO(1st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2ndstage) units, total flow from two (2) HP Feed pumps to be considered. b) For UF, acid required as per process calculation to be considered </td><td>To be designed for design dosage rate & design flow for one (1) day</td><td> a) For RO(1st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2ndstage) units, total flow from two (2) HP Feed pumps to be considered </td></tr> <tr> <td>6)</td><td>Capacity of each tank</td><td>To store 10 days requirement</td><td></td><td>To hold 8 hours requirement</td></tr> <tr> <td>7)</td><td>Type of Tank</td><td>Horizontal atmospheric vessel</td><td>Vertical, atmospheric; Covered</td><td>Vertical, atmospheric; Covered</td></tr> <tr> <td>8)</td><td>Material of Construction</td><td>MSRL</td><td>MSRL/ FRP</td><td>MSRL/ FRP</td></tr> <tr> <td>9)</td><td>Accessories</td><td colspan="3">Manholes / Hand holes, Filling Connection, Vent, overflow, drains, Fume absorbers, valves operating platform, ladders</td></tr> </tbody> </table>				No	Description	Parameters/ Data					requirement of Acid	store acid for UF	store acid for one day requirement for pH control	3)	Number of tanks	Three (3)	Two (2)	Three (3)	4)	Design Dosage rate (Dosage rate indicated are minimum)	Total volume to be sized for dosing of 25 ppm in RO(1 st & 2 nd) (at the upstream of and Cartridge filters), plus dosage rate for UF	As recommended by UF provider	Total volume to be sized for dosing of 25 ppm in in RO(1 st & 2 nd) (at the upstream of and Cartridge filters),	5)	Design Quantity of Water to be dosed with acid for estimation of storage volume	a) For RO(1 st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2 nd stage) units, total flow from two (2) HP Feed pumps to be considered. b) For UF, acid required as per process calculation to be considered	To be designed for design dosage rate & design flow for one (1) day	a) For RO(1 st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2 nd stage) units, total flow from two (2) HP Feed pumps to be considered	6)	Capacity of each tank	To store 10 days requirement		To hold 8 hours requirement	7)	Type of Tank	Horizontal atmospheric vessel	Vertical, atmospheric; Covered	Vertical, atmospheric; Covered	8)	Material of Construction	MSRL	MSRL/ FRP	MSRL/ FRP	9)	Accessories	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, Fume absorbers, valves operating platform, ladders		
No	Description	Parameters/ Data																																															
		requirement of Acid	store acid for UF	store acid for one day requirement for pH control																																													
3)	Number of tanks	Three (3)	Two (2)	Three (3)																																													
4)	Design Dosage rate (Dosage rate indicated are minimum)	Total volume to be sized for dosing of 25 ppm in RO(1 st & 2 nd) (at the upstream of and Cartridge filters), plus dosage rate for UF	As recommended by UF provider	Total volume to be sized for dosing of 25 ppm in in RO(1 st & 2 nd) (at the upstream of and Cartridge filters),																																													
5)	Design Quantity of Water to be dosed with acid for estimation of storage volume	a) For RO(1 st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2 nd stage) units, total flow from two (2) HP Feed pumps to be considered. b) For UF, acid required as per process calculation to be considered	To be designed for design dosage rate & design flow for one (1) day	a) For RO(1 st stage) units, total flow from two (2) HP Feed pumps to be considered. b) For PT System of RO(2 nd stage) units, total flow from two (2) HP Feed pumps to be considered																																													
6)	Capacity of each tank	To store 10 days requirement		To hold 8 hours requirement																																													
7)	Type of Tank	Horizontal atmospheric vessel	Vertical, atmospheric; Covered	Vertical, atmospheric; Covered																																													
8)	Material of Construction	MSRL	MSRL/ FRP	MSRL/ FRP																																													
9)	Accessories	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, Fume absorbers, valves operating platform, ladders																																															
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 68 OF 88																																														

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	5-E) Acid Handling, Storage and Dosing System			
	5-E-1) Acid Unloading cum Transfer Pumps			
	No	Description	Parameters/ Data etc as applicable	
	5-E-3) Acid Dosing Pumps			
	No	Description	Parameters/ Data	Parameters/ Data
	1)	Pump Designation	Acid Dosing Pumps – SWRO & RO	Acid Dosing Pumps – UF
	2)	Purpose	For dosing Acid solution at upstream of cartridge filters - SWRO plant	For dosing Acid solution at upstream of cartridge filters - UF plant
	3)	Chemical to dosed	Hydrochloric Acid of about 5% concentration	Hydrochloric Acid of about 5% concentration
	4)	Type	Simplex hydraulically operated Diaphragm type	
	5)	Numbers required (Working +Standby)	Two (2)(1 W+ 1 S) for each	Two (2) (1 W+ 1 S)
	6)	Duty	Continuous	Intermittent
	7)	Design Quantity of Water to be dosed	Total flow of three (3) Filter Feed pumps	Total flow of UF Feed pumps
	8)	Design flow rate of each dosing pump	To suit minimum dosage rate of 25 ppm	To suit minimum dosage rate of 25 ppm
	9)	Rated Head of pump	As required	As required
	10)	Capacity control	----- 0 --100% of capacity by micrometer dial ----- -	
11)	Pump stroke speed per minute	----- 100 maximum -----		
12)	Material of Construction			
	a) Liquid end (pump head valve, valve housing, etc)	----- PVC -----		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 69 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एन टी पी सी NTPC
	5-E-3) Acid Dosing Pumps				
	No	Description	Parameters/ Data	Parameters/ Data	
		,valve spring			
		b) Diaphragm	-----	TEFLON -----	
		c) Packing	-----	TEFLON -----	
		d) Shaft	Hardened steel EN8-BS-970 / As per manufacturer's Standard suiting to Chemical		
	13)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required		
	5-F) Alkali Handling, Storage and Dosing System				
	5-F-1) Alkali Unloading Pumps & Alkali transfer cum recirculation pumps				
	No	Description	Unloading Pumps	Transfer cum recirculation pumps	
	1)	Purpose	To pump Alkali from Tankers to Bulk Alkali Storage Tanks.	a)To pump Alkali from Bulk Alkali Storage Tanks to Acid measuring tanks and preparation tanks. b) To pump alkali prepared using flakes from alkali preparation tanks to Bulk alkali storage tanks	
	2)	Chemical to be used	-----	Sodium Hydroxide (48% Conc) ---- -----	
	3)	Type	-----Horizontal Centrifugal -----		
	4)	Numbers required (Working +Standby)	Two (2) (1 W+ 1 S)	Two (2) (1 W+ 1 S)	
	5)	Duty	Intermittent	Intermittent	
	6)	Design flow rate of each pump	15 Cu.M/hr	10 Cum/hr	
	7)	Rated Head of pump	As required	As required	
	8)	Maximum Pump Speed	-----1500 rpm ----- -----		
	9)	<u>Material of Construction</u>			
		a) Casing	-----	SS-316 -----	
		b) Impeller	-----	SS-316 -----	
	c) Wearing Rings		SS-316		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 70 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
	5-F) Alkali Handling, Storage and Dosing System				
	5-F-1) Alkali Unloading Pumps & Alkali transfer cum recirculation pumps				
	No	Description	Unloading Pumps	Transfer cum recirculation pumps	
		d) Shaft		SS-410	
		e) Shaft Sleeve		SS-410	
	10)	Type of Shaft Sealing	Mechanical Seal as per Mfr Std		
	11)	Sets of Hoses with coupling & Diaphragm type Isolation Valves			
		a) Number of Sets Required	Two (2)	NA	
		b) Size of hose/ Valve	80 mm NB	NA	
		c) Length of hoses	20 meters (minimum)	NA	
		d) Material of hose	Chemical resistant, UV inhibited PVC	NA	
	12)	Accessories Required for Pump	Coupling guard, drain plugs, vent valves etc		
	13)	Other Technical Requirements	Refer sub-section titled “Horizontal Pumps” in Part-B of Technical Specification		
	5-F-2) Bulk Alkali Storage Tanks & Preparation Tanks				
	No	Description	Bulk Alkali Tanks	Alkali Preparation Tanks	
	1)	Purpose	To store one month requirement of Alkali	To Prepare alkali from flakes	
	2)	Chemical to handled	Sodium Hydroxide of 48% concentration		
	3)	Number of tanks	Two (2)	One (1)	
	4)	Capacity of Tank	To be designed for design dosage rate & design flow for one month	2 Cum	
	5)	Design Dosage rate (Dosage rate indicated are	a) For dosing @ of 5 ppm in permeate of SWRO for pH control, plus	-----	
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 71 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC	
	5-F-2) Bulk Alkali Storage Tanks & Preparation Tanks				
	No	Description	Bulk Alkali Tanks	Alkali Preparation Tanks	
		minimum)	b) For dosing @ 5 ppm in permeate of 2 nd Stage RO system for pH control and c) Dosage rate for UF As recommended by UF provider		
	6)	Design Quantity of Water to be dosed with alkali for estimation of storage volume	a) For permeate pH control, gross capacity of all the streams of SWRO & and one RO train to be considered; b) For UF alkali required as per process calculation to be considered	-----	
	7)	Capacity of each tank	To store 15 days requirement	-----	
	8)	Type of Tank	Horizontal atmospheric vessel	Vertical, atmospheric; Covered	
	9)	Material of Construction	MSRL	MSRL	
	10)	Number of agitators	NA	One (1)	
	11)	Shaft Material of Agitator	NA	SS-316	
	12)	Impeller Material of Agitator	NA	SS-316	
	13)	Accessories	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, CO ₂ absorbers, valves operating platform, ladders etc as applicable		
	5-F-3) Alkali Measuring Tanks				
	No	Description	Measuring Tanks (for UF)	Measuring Tanks (for RO(1 st & 2 nd) Plants)	
	1)	Purpose	To prepare & store	To prepare & store alkali for pH	
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 72 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एन टी पी सी NTPC
	5-F-3) Alkali Measuring Tanks				
	No	Description	Measuring Tanks (for UF) alkali for UF	Measuring Tanks (for RO(1 st & 2 nd) Plants) control of permeate	
	2)	Chemical to handled	Sodium Hydroxide of 48% concentration	Sodium Hydroxide of 5% concentration	
	3)	Number of tanks	Two (2)	Two (2)	
	4)	Design Dosage rate (Dosage rate indicated are minimum)	As recommended by UF provider	Total volume to be sized for dosing of 5 ppm in permeate of RO(1 st & 2 nd) for pH Control , plus	
	5)	Design Quantity of Water to be dosed with acid for estimation of storage volume		For permeate pH control, capacity of all the trains of SWRO(1 st stage) & and one RO train(2 nd stage) to be considered.	
	6)	Capacity of each tank	To hold 12 hours requirement	To hold 12 hours requirement	
	7)	Type of Tank	Vertical, atmospheric; Covered		
	8)	Material of Construction	MSRL/ FRP		
	9)	Number of agitators	One (1)	One (1)	
	10)	Shaft Material of Agitator	SS-316	SS-316	
	11)	Impeller Material of Agitator	SS-316	SS-316	
	12)	Accessories	Manholes / Hand holes, Filling Connection, Vent, overflow, drains, CO ₂ absorbers, valves operating platform, ladders etc		
	5-F-4) Alkali Dosing Pumps				
	No	Description	Parameters/ Data	Parameters/ Data	
	14)	Pump Designation	Alkali Dosing Pumps – SWRO & RO	Alkali Dosing Pumps – UF	
	15)	Purpose	For dosing Alkali solution in permeate of SWRO &	For dosing Alkali solution in permeate of UF plant	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 73 OF 88	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				एनटीपीसी NTPC
	5-F-4) Alkali Dosing Pumps				
	No	Description	Parameters/ Data	Parameters/ Data	
			RO plant		
	16)	Chemical to dosed	Sodium Hydroxide solution of about 5% concentration	Sodium Hydroxide solution of required concentration	
	17)	Type	Simplex hydraulically operated Diaphragm type		
	18)	Numbers required (Working +Standby)	Two (2)(1 W+ 1 S) for SWRO & RO each	Two (2) (1 W+ 1 S)	
	19)	Duty	Continuous	Continuous	
	20)	Design Quantity of Water to be dosed	Total permeate flow of three (3) SWRO trains/streams	As per requirement	
	21)	Design flow rate of each dosing pump	To suit minimum design dosage rate of 5 ppm	As per requirement	
	22)	Rated Head of pump	As required	As required	
	23)	Capacity control	----- 0 --100% of capacity by micrometer dial -----		
	24)	Pump stroke speed per minute	----- 100 maximum -----		
	25)	Material of Construction			
		e) Liquid end (pump head valve, valve housing, etc) ,valve spring	----- SS-316 -----		
		f) Diaphragm	----- TEFLON -----		
		g) Packing	----- TEFLON -----		
		h) Shaft	Hardened steel EN8-BS-970 / As per manufacturer's Standard suiting to Chemical		
	26)	Accessories	Check valves, Pressure Dampeners, Safety Relief valves etc as required		
	5-F-5) Activated Carbon Filter for Alkali				
	No	Description	AC Filter		
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM				
	PAGE 74 OF 88				

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC
	5-F-5) Activated Carbon Filter for Alkali		
	No	Description	AC Filter
	1)	Purpose	To filter impurities from alkali.
	2)	Chemical to handled	NaOH
	3)	Number	One (1)
	4)	Capacity of filter	10 Cum/hr
	5)	Design surface flow rate	12 Cum/hr/SqM
	6)	Type of Vessel	Vertical Cylindrical Pressure vessel with dished ends
	7)	Filter media	Activated Carbon
	8)	Properties of Media	a) Total surface area (m2/g): min 850. b) Particle density (wetted in water) 1.3-1.4 g/cc c) Mean particle Diameter is 0.6 - 0.8 mm In case of needle / cylindrical type and 1.5 - 2.0 mm in case of Granular type. d) Iodine Number shall be not less than 1000 mg/g e) Abrasion Number shall be minimum 95 by ASTM Method . f) Ash content shall be maximum 7% g) Mean particle length in case of needle / cylindrical type shall be 2.2 - 2.4 mm h) Size in case of Granular type shall be 4 - 16 mesh
	9)	Minimum bed depth of AC media	1000 mm
	10)	Free Board over media depth	75%
	11)	Material of Construction	MSRL
	12)	Accessories	Manholes / Hand holes, Vent, overflow, drains, valves operating platform, ladders etc as applicable
	5-F-6) Miscellaneous Equipments for Chemical Handling, Storage & Dosing System		
	No	Description	Parameters
	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-III-A4 EQUIPMENT COOLING WATER SYSTEM		
	PAGE 75 OF 88		

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एन टी पी सी NTPC	
	5-F-6) Miscellaneous Equipments for Chemical Handling, Storage & Dosing System			
	No	Description	Parameters	
	1)	Monorail hoist	1 Tonne capacity with lifting beam for handling carboys from chemical storage area to chemical preparation area and vise versa	
	2)	Number of hoists	As required to suit the layout	
	3)	Weighing Scale	One number of 0-500 Kg capacity for weighing chemicals	
	5-F-7) SODIUM HYPOCHLORITE (NaOCl) HANDLING, STORAGE AND DOSING SYSTEM FOR UF			
	A) NaOCl UNLOADING CUM TRANSFER PUMPS			
	No	Description	Parameters/ Data	
	1)	Purpose	a) To pump Acid from Tankers to Bulk NaOCl Storage Tanks and b) To transfer NaOCl from Bulk Acid Storage Tanks to Acid Measuring tanks	
	2)	Chemical to be used	NaOCl - 10- 30% Concentration	
	3)	Type	Horizontal Centrifugal	
	4)	Duty	Intermittent	
	5)	Design flow rate of each pump	15 m³/hr	
	6)	Rated Head of pump	As required	
	7)	<u>Material of Construction</u>		
	a)	Casing	PP/As per manufacturer's Standard suiting to Chemical	
	b)	Impeller	PP/As per manufacturer's Standard suiting to Chemical	
	c)	Shaft	PP/EN-8/As per manufacturer's Standard suiting to Chemical	
	d)	Shaft Sleeve	PP/As per manufacturer's Standard suiting to Chemical	
	e)	Sets of Hoses with coupling & Diaphragm	Two (2)	
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 76 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
	No	Description	Parameters/ Data		
		type Isolation Valves			
	B). UF BULK NaOCl STORAGE & PREPARATION TANKS				
	No	Description	Bulk Tanks		Measuring Tanks
	1)	Chemical to be handled	NaOCl - 10- 30% Concentration		-
	2)	Design Dosage rate (Minimum)	---		As recommended by UF provider
	3)	Type of Tank	Horizontal atmospheric vessel		Vertical, atmospheric; Covered
	4)	Material of Construction	Mild steel rubber lined/ Mild steel		Mild steel rubber lined/ FRP
	5)	Total Capacity	To be designed for design dosage rate & design flow for one (1) month		To be designed for design dosage rate & design flow for one (1) day
	6)	Accessories	Manholes/hand holes, filling connection, vent, overflow, drains, fume absorbers, valves operating platform, ladders etc. as applicable		
	C). NaOCl DOSING PUMPS FOR UF				
	No	Description	Parameters/ Data		
	1)	Pump Designation	NaOCl Dosing Pumps-UF		
	2)	Purpose	For Ultra-filtration plant		
	3)	Chemical to dosed	Sodium Hypochlorite soln.		
	4)	Type	Simplex hydraulically operated Diaphragm type		
	5)	Duty	Continuous		
	6)	Design flow rate of each dosing pump	As recommended by UF provider		
	7)	Rated Head of pump	As required		
	8)	Capacity control	---- 0 to 100% of capacity by micrometer dial ----		
9)	Pump stroke speed per minute	----- 100 maximum ----- --			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 77 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES							
	No Description Parameters/ Data							
	10) a) b) c) Liquid end Diaphragm Shaft - As per manufacturer's Standard suiting to Chemical - - Teflon/As per manufacturer's Standard suiting to Chemical - EN8-BS-970 / As per manufacturer's Standard suiting to Chemical <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-III-A4 EQUIPMENT COOLING WATER SYSTEM</td></tr> <tr><td colspan="2"></td><td>PAGE 78 OF 88</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-III-A4 EQUIPMENT COOLING WATER SYSTEM			PAGE 78 OF 88
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-III-A4 EQUIPMENT COOLING WATER SYSTEM					
		PAGE 78 OF 88						

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
7.09.00	ANNEXURE- 2			
	CONTROL & OPERATION PHILOSOPHY NTECL(VALLUR) TPP (3 X500 MW)			
	All the systems covered under this package shall be controlled as mentioned in relevant Sub-sections of Control & Instrumentation. The required instruments are generally shown in the relevant tender P & ID. However, additional instruments/limit switches/analysers etc required to meet the intended control scheme/ philosophy and to meet the system requirement shall be provided by the Contractor within the Contract price. The control scheme/philosophy related to UF/SWRO/RO and associated HP pumps and or Energy Recovery units are to be detailed out by Equipment supplier based on their experience. Additional instruments/analysers over and above the specified items shall be provided by them within the contract price to implement the required/desired/recommended control philosophy. The Instrumentation & Control system shall be provided as indicated in various subsections of this Technical specification. The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalised with successful bidder during detailed engineering.			
7.09.01	GENERAL CONTROL PHILOSOPHY			
	The control philosophy of various systems are described below. However for all the systems, following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement.			
7.09.01.01	The control philosophy of various systems are described below. However for all the systems, following basic process related interlocks, alarms /pre-warning signals shall be implemented in the control system as per system requirement. a) Among the equipments, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc through control system. b) <u>Permissive & Interlocks:</u> 8) Starting & tripping of pumps with respect to liquid level in the respective sump/tanks or liquid pressure in the suction lines. 9) Starting & tripping of agitators with respect to liquid level in the respective sump/tanks. 10) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be). 11) Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head. 12) Stopping/ tripping of equipments due to abnormal parameters related to safety of equipments like high vibration, very high bearing			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 79 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc as applicable based on the recommendations of Equipment Supplier. 13) Automatic opening of the pump re-circulation valve to pre-set percentage, in case of failure of opening of pump discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer. 14) Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be. c) <u>Alarms /Signals</u> 5) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc 6) Failure of starting of equipments such as pumps, blowers etc upon start command. 7) Tripping of equipments due to protection logic. 8) In addition, the control system shall facilitate the operator to know the status of various equipments (Whether equipment is running or stopped or tripped etc, whether the equipment is selected for operation/ standby duty /maintenance mode etc as the case may be), all the manual or automatic valves, (whether the valves is open or closed), dampers, tanks (full / empty), process parameters such as flow, pressure, temperature, quality of water etc. 7.09.01.02 Complete Ultra-filtration plant, is conceived with multiple skid/trains /streams. The product water is envisaged to be stored in storage tank & further fed to existing Desalination plant. It shall be possible to operate the Ultrafiltration plant to its full design capacity or in part capacity by isolation of any of the skid/train/stream. This operational flexibility built into the scheme shall be achievable thru control system. 7.09.01.03 Complete operation of the plant/ each system/ sub-systems shall be possible in Auto/semi-auto/ remote-manual mode. In Auto-mode operation philosophy and sequence described in subsequent paragraphs shall be achieved without any intervention of operator. In semi-auto mode, operator shall select the sequence of operation of each sub-systems / each stream/ each tank as the case may be. In manual-mode, each equipment / valves etc shall be operated in sequence thru OWS either for testing, production of water or checking the logic control & of interlocks as the case may be. In addition, it shall be possible to operate the complete plant by opening the valves manually & starting the equipments individually as the case may be. 7.09.01.04 Complete Plant operation shall be exhibited through mimics on OWS/LVS as the case may be. The mimics shall indicate the operating status of different filters, RO			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 80 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	module assembly, exchange units, pumps, tanks, valves, blowers etc. Colour coding, (as per Employer's standard coding system which will be furnished after award) shall be used to differentiate lines for different service such as normal water line, backwash line, rinse line, acid alkali line etc.			
7.09.01.05	The control system shall employ a logical system which will link the various steps such as closing/opening of different valves, starting/stopping of various pumps etc which makes a sequence. The logic system will adhere to the correct sequence of operation and pre-determined /pre-set time duration. The system shall be interlocked so that the necessary pre-requisite for each step are completed prior to proceeding to the next step. Facility for overriding any step/criteria should be provided.			
7.09.01.06	It shall be possible to switch mode of operation from auto/Semi-auto to manual or vice-versa at any moment and the operation shall proceed from the step at which the changeover takes place automatically or through manual command as the case may be.			
7.09.01.07	The system shall have necessary safety system, locking system and manual emergency system. The Safety system for any sequence/step shall check the opening of the required valves and closure of remaining valves of the plant to avoid mal operation. During automatic sequential operation, if any pre-requisite criteria is not fulfilled or is missing for a pre-determined time interval, the steps should not proceed further and an alarm shall be annunciated to let the operator know that the system is blocked.			
7.09.01.08	For all the pumps, blowers etc, which form part of the automatic operation, facilities shall be provided for Auto/remote manual/Local mode selection. Wherever standby equipments are provided, selection of the same shall be possible from remote. The selected standby equipments shall start automatically incase of failure of working equipment. For, other drives which are not involved in continuous running or automatic operation, facilities shall be provided for remote/local selection from remote			
7.09.02	CONTROL PHILOSOPHY OF VARIOUS SUB-SYSTEMS <u>Storage & Pumping System:</u> a) Normally drawl of product water requirement plant shall be from a single tank while the other tanks shall be in filling mode from the SWRO streams/RO trains. Operation of pumps which draw water from the storage tanks shall be interlocked with the tank level and /or pressure at the suction header, high pressure at the discharge header as the case may be. The field instruments provided by Bidder along with tanks & suction header and instruments supplied by Employer (supplied with Product Pumps) shall be used for implementation of such logic b) It shall be possible by the Operator one or more tanks for drawl mode and other for filling mode. In auto mode, the tank (s) under drawl mode shall switch over to filling mode at a pre-set level in tank and drawl for the plant shall be continued from the tanks which were under filling mode. Upon reaching high level in all the storage tanks, the running streams/trains shall			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 81 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
7.09.03	be shut-down in sequence. Similarly the at low level in all the tanks shall initiate starting of stream(s) in sequence which are under standby mode/stopped. <u>SWRO/RO System.</u> a) RO plant shall be operated and controlled thru control system. All necessary field instruments, analyzers and controls shall be provided by Bidder. Facility for starting and stopping of pumps, selection of stream shall be provided in the control system. b) The system shall provide the following: i) Alarms for, High permeate conductivity, Low pH of feed water, High pH of feed water, high conductivity of reject, high hardness of feed water, high feed water temperature, availability of chemical dosing system such as low level in dosing tanks, status of dosing pumps etc ii) Continuous monitoring for Feed temperature, Feed pH, conductivity of feed water, concentrate & permeate, SDI of Feed water, ORP of feed water, pressure of Feed water, permeate & concentrate, flow of feed water & Permeate. c) The HP pumps shall be operated thru control system. Start/ Stop of HP pump shall be interlocked with opening & closing of suction & discharge valves. The pump shall start with its discharge valve closed and on stop/trip command the discharge shall be interlocked to close before the pump stops. Low pressure in the pump suction and high pressure in the pump discharge shall raise an alarm and trip the pump. d) The operation and control philosophy & instrumentation of Energy recovery units (ERU) shall be as per the recommendation of the manufacturer. e) Permeate transfer pumps. The pump shall be provided with interlocks to trip the pump on Low suction level. The low-pressure signal from low pressure switch in the discharge header shall start the standby pump, when the system is in auto mode. f) Motor drives provided with winding temperature measurement & bearing temperature shall sense high & very high temperature for alarm and tripping receptively thru control system. g) The HP pumps and motor bearings shall be provided with vibration monitoring for measuring vibration levels and vibration “High” and “High-High” alarm shall be annunciated. h) Additionally HP pump shall be tripped / shutdown under High conductivity in the RO permeate line, high pH in the Feed water line, high feed water temperature, low level in chemical dosing tank, high feed pressure, high ORP value, high Differential pressure across permeators, high SDI in feed water		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 82 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	and failure of flow control valve i) The following control and instrumentation are provided in each of the permeator assembly unit as a minimum: 1) A pressure control valve on the pump discharge line to control feed pressure during operation, during start-up and control salinity during normal operation. 2) Flow control valve on the concentrate line to set the recovery and for ratio control. 3) Conductivity analyzer in permeate and concentrate line to sense, indicate of TDS & salt passage and to derive the recovery of the unit. 4) The ORP electrode signal shall activate an alarm and can used to shutdown the HP pump when chlorine is detected 5) A pressure element transmitter in the permeate line to measure, indicate pressure. 6) pH analyzer in permeate and concentrate lines to sense, indicate pH values. 7) Flow element / transmitter in the permeate line to measure, indicate and provide analysis flow in the permeate line and provide the control signal for the control valve in the concentrate line. 8) Flow element/transmitter in the feed line to measure feed flow. 9) Automatic drain valve/dump valve in the permeate line to provide permeate drain when the TDS in permeate exceed the design limits. 10) Automatic valves in the feed and concentrate lines to connect a clean-in-place and flushing system. 11) Differential pressure element/transmitter mounted with connection on the concentrate brine and feed line to measure, indicate pressure drop in the permeator i.e. to measure severity of fouling. 12) Local Pressure indicator in the feed, concentrate and the permeate 13) Temperature element/transmitter in the feed to measure, indicate and analyze feed temperature. 14) Local Temperature indicators in feed line. 15) Automatic valve on the feed, concentrate and permeate line to facilitate selection/isolation of streams/trains. 16) Sample ports on the feed, concentrate and permeate (to enable		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 83 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
7.09.04	evaluation of system performance). 17) Sample port on each pressure vessel permeate outlet to facilitate troubleshooting. 18) Trend analysis shall be possible for various parameters being measured thru instruments as listed above thru control system. j) <u>Clean in place system:</u> The operation of agitators/mixers of chemical tank can also be initiated manually by means of local start/stop push buttons apart from automatic operation. During normal operation mixing shall be automatically started on the initiation of cleaning operation. The cleaning system pumps shall be started during the cleaning cycle progress. The pumps shall be provided with interlocks to trip on low level of chemical tanks. The cartridge filter shall be provided with a differential pressure measurement to monitor the pressure drop across the filter. Selection of RO block / train to be cleaned shall be manual through control system. k) <u>Flushing System:</u> These pumps shall be selected started and stopped either locally thru push button or remotely thru control system. During normal operation pump operation shall be automatically started on the initiation of flushing operation. Auto / manual selection switch is provided to select the mode of operation. The pump shall be provided with interlocks to trip the pump on Low suction level. The low-pressure signal from low pressure switch in the discharge header shall start the standby pump, when the system is in auto mode. Selection of RO block / train to be flushed cleaned shall be manual through control system. l) Suck-back The operation of suck-back shall be automatic			
	ULTRA FILTRATION SYSTEM 1) UF plant shall be operated and controlled thru control system. All necessary field instruments, analyzers and controls shall be provided by Bidder. Facility for starting and stopping of pumps, selection of stream shall be provided in the control system. 2) The system shall provide the following: i) Alarms for, High permeate SDI, availability of chemical dosing system such as low level in dosing tanks, status of dosing pumps etc. ii) Continuous monitoring for pressure of Feed water, flow of feed water & Permeate.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 84 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	3) The feed pumps shall be operated thru control system. Start/ Stop of feed pump shall be interlocked with opening & closing of suction & discharge valves The pump shall start with its discharge valve closed and on stop/trip command the discharge shall be interlocked to close before the pump stops. Low pressure in the pump suction and high pressure in the pump discharge shall raise an alarm and trip the pump. 4) The operation and control philosophy & instrumentation of variable frequency drive for UF units (VFD) shall be as per the recommendation of the manufacturer. 5) Also feed pump shall be tripped / shutdown under high feed pressure, high Differential pressure across permeators. 6) The following control and instrumentation are provided in each of the permeator assembly unit as a minimum: a) A pressure control valve on the pump discharge line & Flow control valve on the concentrate line to set the recovery in case the bidder's process envisages. b) SDI analyzer in permeate line to sense, indicate of turbidity c) Flow element/transmitter in the permeate line to measure, indicate and provide analysis flow in the permeate line. d) Flow element/transmitter in the feed line to measure feed flow. e) Automatic drain valve/dump valve in the permeate line to provide permeate drain when the SDI in permeate exceed the design limits. f) Automatic valves in the feed and concentrate lines to connect CEB and flushing system. g) Automatic valve on the feed, concentrate and permeate line to facilitate selection/isolation of streams/trains. h) Sample ports on the feed, concentrate and permeate (to enable evaluation of system performance). i) Sample port on each pressure vessel permeate outlet to facilitate troubleshooting. J) Trend analysis shall be possible for various parameters being measured thru instruments as listed above thru control system. 7) Flushing System: These pumps shall be selected started and stopped either locally through push button or remotely thru control system (Option for local / remote control shall be selected through OWS of the control system.) During normal operation pump operation shall be automatically started on the initiation of flushing operation. Auto / manual selection switch is provided to			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 85 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
7.09.05	select the mode of operation. The pump shall be provided with interlocks to trip the pump on Low suction level. The low-pressure signal from Pressure transmitter in the discharge header shall start the standby pump, when the system is in auto mode. Selection of UF block / train to be flushed cleaned shall be manual through control system. 8) Filter backwash operation shall be initiated whenever head loss across the filter reaches preset point or after specified filtration cycle or at the specified effluent quality of high SDI. The logic to be selected shall be decided by Operator through control system. Upon initiation, filter backwash shall proceed automatically by opening and closure of various valves, starting and stopping of blowers etc. putting the filter stream/trains shall be automatic.		
	Pre-Treatment System. PT plant shall be operated and controlled thru control system All necessary field instruments, and controls shall be provided by Bidder. Facility for starting and stopping of pumps, selection of stream shall be provided in the control system A. Clarifiers a) Sea Water Flow (0 to 100%) through the Clarifiers shall be regulated automatically by means of inlet control Valve (s) with respect to the Water level in the Clarified Water storage tank. It shall be possible for the operator to take over flow regulation control manually from the OWS so that as per the plant requirement, operator may regulate the control valve opening. b) Isolation of clarifier (closure of inlet/ outlet gates of Clarifiers), shall be available to the operator through control system and Chemical dosing shall be prevented by closing the valves in dosing lines to the clarifier (s) which is (are) isolated. Facility for starting and stopping of Flash mixer agitator and flocculator paddles shall be provided from control system upon selection of clarifiers into service. c) Turbidity, pH, Oxidization Reduction Potential (ORP) and TOC at the outlet of clarifiers shall be monitored. d) The frequency of de-sludging operation and duration of valve opening shall be set through timers. The dewatering pumps shall be provided with interlocks to trip the pump on very low suction level. A low-pressure signal from the low-pressure switch in the discharge line shall start the standby pump, when the system is in auto mode. At a specific water level in the sump, selected pump (s) shall start and sludge shall be pumped out to the ash slurry sump. B. Filters a) Filter feed pumps of 1st Stage SWRO/RO (2nd Stage) Plant Feed pumps shall be provided with interlocks to trip the pump on Low suction level. The low-		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 86 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
7.09.06	pressure signal from low-pressure switch in the discharge header shall start the standby pump, when the system is in auto mode. b) Filter backwash operation shall be initiated whenever head loss across the filter reaches preset point or after specified filtration cycle (say 24 or 48 hours – to be decided during operation stage) or at the specified effluent quality of differential i.e high turbidity & high SDI. The logic to be selected shall be decided by Operator through control system. Upon initiation, filter backwash shall proceed automatically by opening and closure of various valves, starting and stopping of blowers etc. Putting the filter stream/trains shall be automatic. c) Any one of the blower can be selected and kept ready for backwash operation while the balance shall be identified for standby duty. .Filter blowers shall be operated by the filter backwash logic. Automatic on/off vent valve in scouring air header may be utilized to start / stop the blower with its vent valve open to reduce the starting current. A pressure transmitter provided in the header shall start the standby blower on Low header pressure, and trip the working blower's on high pressure. A high temperature switch shall be provided in the discharge side of the blower and shall be used as a start permissible and blower protection. A flow transmitter shall be provided in the discharge header for monitoring the airflow rate. d) The filter back wash pump shall be operated by filter back wash logic. The pump shall be provided with interlocks to trip the pump on level in backwash water storage tank. A low-pressure signal from the low-pressure switch in the discharge line shall start the standby pump, when the system is in auto mode. e) Continuous monitoring of differential pressure across Cartridge filters, water quality at the outlet (SDI, pH, Oxidization Reduction Potential) of Cartridge filters shall be provided and abnormal parameters shall be annunciated. The TDS of influent to the RO plant shall monitored using a conductivity analyzer located on the main header downstream of the cartridge filter. The SDI analyzer shall be installed to monitor the silt density index in the feed water to the RO membrane. f) In addition to remote control facility, filter backwash operation shall be possible to be carried out manually by the operator by opening of various valves and starting and stopping of blowers at their location. Accordingly, local start/stop facility shall be provided. Option for local / remote control shall be selected through control system. g) Sequence of filter backwashing shall be programmed in line with Manufacturer's recommendations.		
	CHEMICAL STORAGE & DOSING SYSTEM 1) Chemical tank which is proposed to be used for preparation and supply of chemicals at any instant shall be selectable through control system.		
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-III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 87 OF 88

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	2) Unloading operation for Acid and Ferric chloride pumps from tankers shall be done manually through local start/stop push buttons near the pumps. Operator shall supervise unloading and transfer operation by manually adjusting the valves. Preparation, mixing and transfer of alkali from flakes to bulk storage tanks shall be manual by local/start operation of agitators & respective pumps. 3) Transfer operation of Acid and Ferric chloride from bulk tanks shall be possible through control system and as well as manually. 4) Mixing tanks agitators for the Coagulant shall be automatically started and stopped (after set duration) through control system or manually thru local start/stop push buttons. Mixing tank agitators for the Anti-scalant, Anti-oxidant and Coagulant aid shall be started using the local push button station for solution preparation and shall be stopped using a timer & dilution water to fill up the tank shall be manual. Acid tank and Coagulant tank dilution shall be done through control system. 5) Capacity of the metering pump shall be controllable from 10 to 100 % continuously by adjusting the stroke length manually by a micrometer dial calibrated for 0 to 100 % of pump capacity integral with the pump. 6) The metering pumps are controlled from the following control programs / interlocks:- i. Coagulant and coagulant aid dosing pumps shall be started and stopped by the pre-treatment program and the feed adjustment shall be made in control system through pumps stoke controller, depending feed flow to clarifiers. ii. Acid dosing pumps for pH Control(clarifier outlet/RO feed) shall be started and stopped by the respective plant program and the feed adjustment shall be stoke controlled by the pH control program. iii. Anti-scalant and anti-Oxidant dosing pumps shall be started and stopped by the RO plant program and the feed adjustment shall be through stoke controller, depending on the number of RO streams operating and the RO feed rate. iv. In addition to the remote controlling facility, all the metering pumps shall be provided with local start / stop facility. Option for local / remote control shall be selected through OWS of the control system 7) As mentioned in general control philosophy, all the pump operation shall be interlocked with the level in the tanks from which chemical is drawn or level of the tanks to which the chemicals are transferred or unloaded as the case may be. Operation of standby pump(s), upon tripping of working pumps shall be automatic.			
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-III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 88 OF 88

SUB-SECTION-III-A5

LIMESTONE & GYPSUM HANDLING SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00 GENERAL The scope of specification covers is intended to cover design, engineering, manufacturing, supply, erection, commissioning, testing and handling over of Lime Stone Handling Plant & Gypsum Handling plant to be installed for Flue Gas Desulphurisation (FGD) Package. It is to be emphasize, that this specification does not enumerate or describe all the materials and equipment to be supplied and all the services to be performed. However, the offered systems shall be complete in every respect and shall ensure safe and reliable operation of the Plant. This means, all material and equipment shall be provided as required to make a complete, properly functioning installation and shall conform to the highest standards of engineering design, workmanship and international codes/standards. 1.01.00 Space for installation of FGD has been marked in the General Layout Plan in patches as available and before submitting his bid, the bidder should necessary visit the site and get himself familiar with the existing facilities, space availability for FGD & site constraints/condition. Accordingly, bidder has to offer the engineered solution to accommodate his system/equipment within the space identified for FGD. 1.02.00 Based on site visit & space identified for FGD, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. The layout offered shall be such that, it should require minimum modification, demolition and relocation of existing facilities and layout shall be subject to approval of employer. The layout shall covered the complete Limestone handling plant & Gypsum handling facilities and shall clearly list out the modification, demolition and relocation of existing facilities. In the absence of above, the bid shall be deemed incomplete and may be liable for rejection. 1.03.00 A brief scope of Limestone handling plant & Gypsum handling facilities has been elaborated in the relevant paragraphs and shall be engineered based on the storage requirement of crushed limestone of 7 days & gypsum produced for 7days based on the design criteria of major equipment specified in the Technical speciation. 2.00.0 Brief Scope of Work The brief scope specified herein is not exhaustive and any work required for completeness & integration of the complete system to ensuring its satisfactory running shall be in the scope of work and supply for this package. 2.01.00 Limestone Handling Plant (LHP) 2.01.01 Limestone will be received to power plant through road by trucks and shall be unloaded by 2x100% Truck Tiplers to discharge Limestone on to 2x100% of Box Feeders/ Surface Feeders/ Bulk-material Receiving Unit. This unit shall feed limestone onto the conveyor before Limestone crusher house. 2.01.02 Truck tippler complex complete with ramp, dust proof enclosure, dust extraction system including all mechanical, electrical, civil and structural works.				
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-III-A5 LIMESTONE & GYPSUM HANDLING PLANTS	PAGE 1 OF 4	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनडीपीसी NTPC		
2.01.03	Limestone shall be conveyed to usage point through double stream of capacity 100% each for conveying & crushing.			
2.01.04	One (1) number Lime stone crusher house (CH) complete with all mechanical, civil, structural, architectural and electrical works etc.			
2.01.05	One number of covered storage shed for crushed limestone alongwith reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable numbers (min. two nos.) of Limestone Storage Silos to store limestone shall be provided.			
2.01.06	Two (2) nos. of paddle feeders installed at the bottom of the reclaim hoppers in limestone storage shed to scoop the limestone from reclaim hoppers and feed limestone on to the underground conveyors. For silos suitable feeders shall be provided for feeding the limestone to reclaim conveyors.			
2.01.07	One (1) No. of lime sampling units, for as received limestone in crusher house.			
2.01.08	Suitable number of ploughs and its actuating mechanism shall be mounted on each conveyor to feed limestone into limestone mill bunkers. Alternatively, suitable nos. fixed Trippers on each conveyor to feed limestone into limestone mill bunkers. Bidder can also offer bucket elevator's for transferring crushed limestone to mill bunkers.			
2.01.09	Minimum four (4) Nos. sump pumps in limestone storage shed (in case of covered storage shed), and two (2) Nos. sump pumps in all TPs completely or partially underground to discharge drain water to LHP plant drain.			
2.01.10	Adequate number of ventilation equipment for ventilating the limestone reclaim hopper, underground tunnel of Conveyors, underground portion of Junction towers and limestone bunker bays (housing tripper/plough conveyors) along with complete with all mechanical, electrical accessories, civil and structural works.			
2.01.11	Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works.			
2.01.12	Exhaust fans to be provided in all battery rooms and all toilets.			
2.01.13	Two (2) numbers conventional enclosure type passenger cum goods elevator having capacity of 10 persons (680kg) to serve various floors of lime stone crusher house & junction tower before mill bunker building (if applicable). Staircase access for machine room shall also be provided by the bidder.			
2.01.14	Two (2) numbers of in line magnetic separators (one no. on each conveyor feeding to crusher house) and two (2) number of suspended magnets, (one no. on each conveyor feeding to Limestone bunker (in case of covered storage shed)) on conveyors.			
2.01.15	Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant).			
2.01.16	Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing,			
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-III-A5 LIMESTONE & GYPSUM HANDLING PLANTS	PAGE 2 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.01.17	Complete dust extraction system for control of fugitive dust in limestone storage shed / Silos, junction towers, crusher house.			
2.01.18	Service water and potable water system for complete limestone handling plant. Water Pump houses & water tanks for service water, cooling water (as applicable) and potable water system.			
2.01.19	Cooling water system (as applicable) for scoop couplings, for complete limestone handling plant. Air cooled type scoop couplings are also acceptable.			
2.01.20	Monorails and electrically operated hoist blocks as well as hand operated chain pulley blocks for servicing/installation/easy replacement of drive machinery, different types of pulleys for all conveyors, GTU and other equipment from ground level to their locations and vice-versa & landing inside the respective Buildings.			
2.01.21	One (1) number of belt vulcanizing machine, suitable for all belt widths in limestone handling system and consumables for one year of consumption.			
2.01.22	Minimum one (1) no. pitless type weigh bidge of capacity 100MT for Road trucks shall be provided each in Limestone unloading area and in Gypsum Loading area.			
2.01.23	All buildings shall be complete with all electrical, civil, structural, architectural works, cable trenches, fire safety walls, foundation, earth mat, fencing, earthing for transformers. All cables, duct banks, trenches, cable trestles shall be complete with associated civil/ structural work and necessary civil foundations.			
2.01.24	Drainage of LHP buildings, tunnels, conveyor galleries and limestone storage shed / Silos including all civil & structural works as detailed out elsewhere in the specification.			
2.01.25	Complete un-used set of all special tools and tackles, which are necessary or convenient for erection, commissioning and overhauling of any equipment. First fill of all consumables, e.g.; oils and lubricants for one year toppings requirements.			
2.01.26	Preservative shop coating, final painting of all structures and equipment.			
3.00.00	GYPSUM HANDLING PLANT (GHP)			
3.01.00	Gypsum shall be conveyed from the vacuum belt filter to the storage shed through a series of double stream conveyors and transfer points/junction towers.			
3.02.00	One number of covered storage shed for gypsum. Alternatively, Eurosilos minimum 2 numbers shall be provided.			
3.03.00	Minimum four (4) Nos. sump pumps in gypsum storage shed with individual discharge piping with fittings and valves upto Bottom Ash Slurry Sump.			
3.04.00	Complete dust extraction system for control of fugitive dust in gypsum storage shed.			
3.05.00	Service water and potable water system for complete gypsum handling plant. Water Pump houses & water tanks for service water, cooling water and potable water system. Common pump house for Limestone handling plant gypsum handling plant is also acceptable.			
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-III-A5 LIMESTONE & GYPSUM HANDLING PLANTS	PAGE 3 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
3.06.00	Suitable number of motorized travelling tripper on each feeding conveyor for feeding the gypsum to the covered storage shed. 3.07.00 Complete ventilation system for gypsum storage shed. 3.08.00 Two (2) numbers of electronic type belt scales (min. one no. on each conveyor feeding to storage shed/silos) for continuous weighing.		
3.07.00			
3.08.00			
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-III-A5 LIMESTONE & GYPSUM HANDLING PLANTS PAGE 4 OF 4

SUB-SECTION-III-B

ELECTRICAL SYSTEM/EQUIPMENT

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	ELECTRICAL SYSTEM / EQUIPMENT			
1.00.00	GENERAL The Contractor's scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, in plant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works indicated in this chapter. The scope includes all interface/ interconnections with the electrical systems under this contract as required and other systems mentioned elsewhere. Unless explicitly stated to be common for all the units, the Contractor shall provide all system/equipment for each of the units. The Electrical scope shall be as described briefly in the following clauses but not limited to it.			
1.01.00	MOTORS Motors along with couplings and coupling guards for all rotating auxiliaries covered under this package.			
1.02.00	HT/ LT SWITCH GEAR HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 0011-109(2)-POE-J-001/Rev-B) Busduct / Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope. HT Switchgear- All 11kV/6.6kV/3.3kV switchboards shall be provided with one spare motor feeder and one transformer feeder on each section as spares whereas 33kV switchboard shall be provided with one transformer feeder on each section as spare. LT Switchgear- All LT Switchgears, Motor Control Centers (MCCs) & AC/DC distribution boards, etc. shall have at least twenty per cent (20%) or minimum two (whichever is higher) fully equipped switch fuse modules of each rating as spares, uniformly distributed over different vertical sections. In addition, all LT Switchgears, MCCs and AC distribution boards shall have as spares at least twenty per cent (20%) of starter modules/MCCB modules or at least one module (whichever is higher) of each rating range of the selection tables (Clause no. 42.00.00) of Tech. Specification Part-B, Sub-Section E-10, equipped for the rating of the largest auxiliary fed from that range. Contractor's scope also includes the Insulating mat for laying in front of 33kV/11kV/6.6kV/3.3kV/415V Switchgears in switchgear rooms under his scope.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 1 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.03.00	DC SYSTEM Battery and Battery Charger Lead acid plante type/ Nickel Cadmium batteries and Float cum boost chargers for plant and equipment in the scope of the contractor, as per system requirement. The DC system (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the Sub-section-II- E1 Part-B of Technical specifications. One set of variable metallic resistor and shunt for each battery rating & location suitable for carrying out the discharge test on the batteries under Contractor's scope shall also be supplied.			
1.04.00	TRANSFORMERS Transformers as per Electrical Single Line Diagram Drg No. 0011-109(2)-POE-J-001/Rev-B and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.			
1.05.00	SWITCHYARD			
1.05.01	The scope of work shall include Design, supply, erection, testing and commissioning of two number 220kV bays in TSTPS for feeding the FGD Tie Transformer, as per the tender SLD associated with TSTPS Stage-I&II. Scope of work shall also include modification as required at TSTPS Stage-I&II Switchyard control room. The switchyards shall employ double main transfer bus scheme. The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage and equipment erection including associated civil & structural works. Further the scope shall also include the cabling, lighting, lightning protection, earthing, association of sub vendors in the erection, supervision, site testing, inspection and commissioning.			
1.05.02	Equipment and materials: I. 220kV AIS equipment: 220kV Equipment: Circuit Breaker, Isolator, Current transformer, Surge arresters, Bus Post Insulators etc. II. 220kV Switchyard materials: - EHIPS Aluminum tube - ACSR 'Moose' Conductor - 10.98mm dia G.S. Earthwire			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 2 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES				
1.05.03 1.05.04 1.06.00	 - Insulators and hardware - Clamps, connectors and spacers - Bay Marshalling kiosks - Material for earthing of all switchyard equipment and Gravel filling. - Armoured Power and control cables, cabling (including interpole and interpanel), cable support angles, cable trays and accessories as necessary for cable erection such as glands, lugs, clamps for cables, ferrules, cable ties, hume pipe etc. cable route markers for buried cable trench are also included in the scope. - Lighting and its accessories The equipment and materials to be supplied by the Contractor shall form a complete 220kV AIS bays, as per scope of work. The equipment and services as detailed in all sections of the bidding documents and as shown on the Single Line diagram shall be within the scope of supply of the Contractor. It is in the interest of the contractor to acquaint himself with the site conditions and scope before submission of offer. The list of items covered under the scope of supplies is as mentioned above. Any items though not specifically mentioned but which are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble free operation shall also be deemed to be included and the same shall be supplied and erected by the Contractor, unless they are specifically excluded in the text of exclusions given in relevant section. CONTROL & PROTECTION OF EHV SYSTEM FOR NEW BAYS a) Control and protection of new 220kV Bays and 220/34.5kV FGD Tie Transformers as per the Tender SLD for FGD system. Protection system shall be provided with Numerical relays. b) Control, Relay protection panels, Relay test kit, Relay Engineering network comprising of one OWS(operator work station), one EWS(Engineering work station), one A4 color printer, one TSE(Time Synchronization Equipment) and networking accessories as per specification. These shall be placed in existing Control room. c) Integration with existing RTU/SDH, existing Bus barprotection system and islanding protection schemes. It is in the interest of the bidder to acquaint himself with the existing schematics and present scope before submission of offer. d) Extending AC/DC supply from owner's existing ACDB/DCDB in switchyard area.				
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;"> TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9 </td> <td style="width: 50%; text-align: center;"> PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT </td> </tr> <tr> <td colspan="2" style="text-align: right; padding-right: 20px;"> PAGE 3 OF 8 </td> </tr> </table>	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 3 OF 8	
TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT				
PAGE 3 OF 8					

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.07.00	e) All protections of 220kV bay systems shall be as per relevant Tender SLDs.			
	f) ABT based energy meters, integration with existing metering system and dummy panels for mounting owner supplied energy meters.			
	g) All control cables within switchyard, interface for transformers and switchyard and main plant for the realization of control and protection scheme.			
1.08.00	h) Recommended relay setting and SCD/ICD files for owner's review and approval.			
	VARIABLE FREQUENCY DRIVE (VFD)			
	The VFD system shall be provided for the equipment drive motors as envisaged in relevant portions of the specifications for driven equipment. The system shall be either Voltage Source Inverter (VSI) or Current Source Inverter (CSI) type. Complete VFD system alongwith associated equipment, HT/LT panel, HT/LT cable, Transformer etc. as applicable shall be provided. Bidder to provide Air conditioned room to house Variable Frequency Drive (VFD).			
1.09.00	CABLES / BUSDUCT			
	All HT/ LT power & control cables required for connection between equipment/devices in contractors scope and cables / Busduct (as applicable) between employers and contractors equipment as per Electrical Single Line Diagram Drg No. 0011-109(2)-POE-J-001/Rev-B.			
	DG SET (IF APPLICABLE)			
Diesel Generator sets of stationary type comprising the following:				
(1.) Diesel Engine Complete with all accessories				
(2.) An alternator directly coupled to engine through flexible/rigid coupling complete with all accessories (CT's & VT's etc.)				
(3.) Control Panel				
(4.) Complete starting arrangement along with battery ,its charger				
(5.) Base frame and foundation bolts etc.				
(6.) Exhaust ducting meeting the statutory requirements, accessories, support structure and foundation bolts.				
(7.) Day Oil Tank, fuel piping and accessories				
(8.) Interconnection piping and accessories				
(9.) Power and control cable gland and lugs at Bidder's equipment for all cables				
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 4 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
1.10.00	(10.) Cable & Cabling between Bidder's equipment. (11.) All lubricants for first filling, consumables and touch up paints etc for commissioning. (12.) Acoustic enclosure meeting the statutory requirements. Necessary ventilation along with necessary starters & lighting shall be provided. CABLING - Contractor shall provide cable trays and their accessories with support arrangements, trestle, trenches, duct bank etc. as required for the cables under his scope of supply for the complete system. However the Cable tray, supports and tray earthing for contractor cables on employer cable vault shall be supplied by employer. - Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109(2)-POE-J-001/Rev-B on the employers nearest trestle in the FGD area as shown in GLP drawing of respective plant subject to availability of space and suitability. In case of non availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. Further Contractor shall supply cables, trestle, trenches, duct bank, cable slit, cable trays and structure etc. from employer trestle to the equipment in FGD area in the contractor's scope. - Contractor shall supply, lay and terminate the cables under his scope of supply - The contractor shall furnish the complete and consolidated feeder list for DC system, LT system and HT system for all loads and drives under the scope of supply of contractor to employer as per the format enclosed at Annexure-A. Contractor shall indicate the location of his equipment's in feeder load list. - Contractor shall provide cable glands and lugs for all equipment's in his scope. - Contractor shall provide all accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, and markers etc. for the cables under his scope. - Contractor shall provide Straight-through jointing kits for HT XLPE power cable, LT power and control cables, Cable termination kits for HT XLPE power cables, Welding receptacles, Trefoil cable clamps, Junction boxes. - Contractor shall provide Galvanised steel pipes/HDPE/hume pipes/PVC pipes, Miscellaneous items like M.S sections etc as required, - Contractor shall provide Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9 PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT PAGE 5 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
1.11.00	10) In addition to other drawings, Contractor shall also prepare complete equipment layout drawings, lighting layout drawings including cable tray layout, routing, Power and control cable schedules etc			
	11) Control interconnection charts shall also be prepared by Contractor			
	LIGHTING			
	Complete lighting system for internal and external areas for the plant, buildings, chimney and equipment in the bidder's scope. Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories Lighting Panels, Chimney aviation light, Receptacles, Switch boxes. Conduits. Lighting Wires, Ceiling fans with regulators, Lighting poles. Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self contained lighting fixture, Maintenance ladders as required are included in the bidder's scope. Mandatory spare parts and maintenance equipment as required.			
1.12.00	EARTHING AND LIGHTNING PROTECTION			
	Complete below ground earth mat and above ground equipment earthing system and lightning protection for the plant and equipment under contractors scope along with its interconnection to the nearest employers earth grid at two points.			
1.13.00	PAINTING FOR ELECTRICAL EQUIPMENT			
	The painting of all electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. The Contractor shall furnish the complete painting details during detailed engineering stage.			
1.14.00	CONSTRUCTION POWER			
	To meet the construction power requirement of the FGD and associated systems, the Employer shall provide Two Number 415V feeders in LT switchgears. The Contractor shall extend supply from these Construction power feeders to meet the construction power requirements at the various locations included in the Contractor's scope through suitably rated Isolation Transformers along with LT distribution boards as per requirement. LT Packaged Sub-stations with isolation transformers may also be used for this purpose. Suitable metering arrangement along with associated Instrument transformers and Metering Cubicles meeting the DISCOM requirements shall be provided by the Contractor at each Construction power feeder, for the measurement of actual energy consumed by the Contractor. The charges only for the actual energy consumed by the Contractor shall be recovered by the Employer based on prevalent rate of DISCOM.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 6 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	Supply, erection, testing and commissioning of all equipments as required for further distribution for meeting the construction power requirements shall be in the Contractor's scope. All necessary statutory requirements for charging construction power of Contractor's network shall be in the Contractor's scope. Construction power supply network is a temporary arrangement which shall be used during the project construction phase. To meet this requirement, the equipments may be arranged by Contractor either by shifting their existing equipments at other installation or by fresh procurement, which may be taken back after commissioning of the project. Even though the Employer shall make all efforts to maintain a continuous supply of construction power, the same is not guaranteed and Employer shall not be responsible for any loss or delays which the contractor may suffer on this account. Also the Employer shall not entertain any claim for exemption/reduction of liquidated damages for delay in execution of the contract due to irregular power supply. Contractor shall arrange/provide necessary backup arrangement on his own for uninterrupted power supply. The Contractor shall maintain a minimum drawl power factor as per DISCOM regulations for their substations, and all such devices for maintaining power factor shall be under the scope of contractor. All temporary wiring must comply with local regulations and will be subject to Employer's inspection and approval before connection to supply. Power supply shall not be provided for use in labor and staff colony.			
1.15.00	TYPE TEST Contractor shall carry out all type tests on electrical equipment's as stipulated in relevant chapters of Part-B of technical specifications.			
1.16.00	MANDATORY SPARES Contractors scope shall include Mandatory Spares of all equipment as mentioned in the relevant portion of Technical Specification.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(2)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 7 OF 8

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES एनटीपीसी NTPC											
Annexure-A	STANDARD FORMAT FOR ELECTRICAL FEEDER LOAD LIST											
	1	2	3	4	5	6	7	8	9	10	11	12
	S. No.	KKS code as in vendor drawing	Description of feeder	Rating (KW/A)	Supply type	Unitised /Station	Normal / Emergency	Feeder type	Running Mode	Recommended cable size	Location Coordinates	Remarks
	GUIDE LINES TO FILL THE FORMAT											
	Column No.	Legend	Designation	Description	Serial Number							
	1	S. No.	1,2,3									
	2	KKS code as in vendor drawing	---		Unique kks of the Equipment							
	3	Description	---		Description of the bidders Equipment							
	4	Rating			Name plate Rating in kW or Amps at 50 deg C							
	5	Supply type			11 KV 3 ph AC / 3.3 KV 3 Ph AC / 415 V 3 Ph AC / 220 V DC / 240 V AC UPS / 240 V AC Non -UPS							
6	Unitised/Station	U		Unit(U) is applied for each unit.								
7	Normal / Emergency	S		STN(S) is applied for common equipment load.								
8	Feeder type	N		Normal Supply								
9	Running Mode	E		Emergency Supply(Emergency supply i.e DG supply)								
10	Recommended cable size	U		Unidirectional Motor								
11	Location	B		Bidirectional Motor feeder								
12	Remarks	H		Heater feeder								
Notes:		S		SFU (switch fuse feeder)								
		W		Working								
		S		Standby								
				Recommended incoming power cable size in: No of runs/no. of cores/ Size in mm2(Al or Cu/ PVC or XLPE								
				Location of the Equipment in coordinates row & columns as per layout								
				Any other relevant information								
				1) Electrical Load list shall be submitted as "MS Excel" sheet also in addition to that in pdf as per the format given above.								
				2) Each Row shall contain data of Only One equipment / load. i.e., if there are two numbers of the same equipment, they shall be indicated in two different rows with unique description & tag number.								

SUB-SECTION-III-C

CONTROL AND INSTRUMENTATION SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00 1.01.00	CONTROL AND INSTRUMENTATION SYSTEM GENERAL a) The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives and auxiliaries in FGD system including Limestone grinding & handling system, Gypsum Dewatering & handling system, RO based Desalination Plant envisaged in Vallur (3x500MW), water treatment plant envisaged in Simhadri (4x500MW) and other systems being provided under the contract, in all regimes of operation in safe and most efficient manner. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer. b) The Contractor shall provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern FGD based power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract. c) The scope of work shall also include all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipment ensuring operability, maintainability and reliability. d) The Contractor shall also provide all the instruments along with cables, JB etc. for equipments / drives and services which may not be specifically stated in this specifications but are required for completeness of the FGD Control system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications. e) The Bidder scope shall include design, manufacture, engineering, inspection & testing at supplier's works, packing, forwarding to site, unloading, erection, testing & commissioning. The following clauses describe the brief scope of supplies. Scope shall be as described briefly in the following clauses but not limited to it. The detailed technical specifications are stipulated under Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications. f) In this project fieldbus (FF/Profibus) based instruments(PT/DPT/TT), Fieldbus based Non-intrusive Electrical actuators are also envisaged which shall be connected to the DDCMIS. The protocol of fieldbus (FF/Profibus) for non-intrusive			
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-III-C C&I SYSTEM	PAGE 1 OF 19	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
1.02.00 1.02.01	electric actuators and fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval. g) Scope defined in PART-A read in conjunction with PART-B has to be provided for each station under LOT-2 package. The scope detailed hereunder in the following clauses is for one set. In this package fieldbus based controls and conventional controls (hardwired 4-20mA/DI/DO) both are envisaged. Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be discussed and finalized during detailed engineering. A. For fieldbus based instruments/ actuators following guidelines shall be followed: a. Actuators which are in main and standby line shall be wired to separate host/ master of FF/Profibus. b. Dual/Triple redundant PT/DPT/TT shall be wired to separate segments. B. Loop Reaction Time (time between field acquisition to field output in control system): a. For Fast Closed loop controls of conventional system, loop reaction time shall be 250ms or better as per process requirement. b. For other Closed loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 500 ms or better as per process requirement. c. For Fast Open loop controls of conventional system (Tie/ trip selection), loop reaction time shall be 100ms or better. d. For other Open loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 1 Second or better as per process requirement. The above shall be suitably demonstrated by the contractor. C. For Foundation Fieldbus & Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided. Specific approval of Employer shall be taken before finalization of protocol of Fieldbus for DDCMIS and for the fieldbus based equipments being connected to DDCMIS like PT/DPT/TT and actuators. Further, the grounding scheme of fieldbus system shall be as recommended by FF/ Profibus standards and Contractor shall submit the detailed scheme at the start of engineering for Employer's approval.			
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-III-C C&I SYSTEM	PAGE 2 OF 19	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	D. The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage and various requirements specified for DDCMIS cabinets in Part-B of this specification will not apply. E. The actuators shall be fully compatible with the valves being provided in this package. Further, 5 Nos. configuration/ diagnostic tool (if applicable) for non-intrusive actuators and 5 nos. configuration/ diagnostic tool (if applicable) for all fieldbus compatible devices shall be provided for each station. F. Twisted pair with round steel wired armour (SWA), Type A fieldbus cable complying to 61158 (detailed Specification as per PART-B), SS JB's with IP-66 and accessories for fieldbus based instruments and actuators shall be provided by the contractor under this package.		
2.00.00	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)		
2.01.00	Latest state of the art microprocessor based Distributed Digital Control, Monitoring & Information System (DDCMIS) shall be provided comprising of the following as a minimum and meeting all requirements specified under Sub-section IIIC-05 DDCMIS of Part -B, Section-VI of Technical Specification and the following annexure of this subsection: IIIC-05G: HMI Hardware IIIC-05J: Security Policies and Procedures IIIC-05K: Guidelines for Fieldbus System The contract quantity of hardware and peripherals of HMIPIS, programming station etc. shall be as per Appendix-I to Part- A, Section-VI of Technical specification read in conjunction with detailed technical specification. For Messaging system, wireless link and Remote Service Centre connectivity (for each type of DDCMIS) the fixed cost (e.g. service provider charges & its equipment etc.) and running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price for the total duration of AMC, i.e. three years.		
2.02.00	Flue Gas De Sulphurization (FGD) DDCMIS		
2.02.01	FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems and other systems being provided under the contract, shall be implemented in the DDCMIS separately for each project. The Control System of FGD DDCMIS has following process blocks as minimum. Any other systems apart from the below mentioned systems shall be		
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-III-C C&I SYSTEM
			PAGE 3 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	included in the common system. Details of control blocks with respect to process blocks shall be finalized during detailed Engineering: FGD DDCMIS consisting of following: (a) Unitized process blocks: i. Unit-1 absorber and associated system ii. Unit-2 absorber and associated system - iii Unit-3 absorber and associated system . . . n) Unit-n absorber and associated system where n is the number of generating unit (b) Common system process blocks: i. Gypsum De watering Handling common system block. ii. Lime stone preparation and handling common system block. iii. Other associated common system including RO based Desalination system, Water treatment system (as applicable) In addition to monitoring and control from the FGD control room, the systems indicated at (a) & (b) shall also be monitored and controlled from each Unit control room. 2.02.02 Depending on the project layout and equipments location of FGD control room and FGD sub systems such as Gypsum handling system, Limestone handling system and other systems being provided under the contract, requirement of Remote Input Output (RIO) shall be finalized during detail engineering, In such cases, contractor to provide RIO on as required basis. Contractor shall place RIO cabinets inside building with air conditioning environment. Building, Air conditioning, power supply for RIO cabinets shall be in contractor's scope. 2.02.03 The Bidder shall provide software license for all software being used in Bidder's System. The software licenses shall be provided for the organization i.e. it should not be site-specific and shall also not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Owner to seek a new license/renew license due to up gradation/change of hardware/machine in Bidder's System at site. All licenses shall be valid for the continuous service life of the plant. 2.03.00 The above system(s) shall include their respective measurement system for signal acquisition, conditioning and signal distribution of various types of inputs/outputs, meeting specification requirements including respective Hardware requirements as stipulated in Sub-section IIIC-05, DDCMIS, Part-B, Section-VI of Technical Specification.		
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-III-C C&I SYSTEM	PAGE 4 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.04.00 2.04.01 2.04.02 2.04.03 2.04.04	The DDCMIS also envisages fieldbus (Foundation fieldbus/ Profibus) complying with IEC61158 for control and signal acquisition from fieldbus compatible actuators and instruments. Field-bus interface modules shall be provided in each FG. Human - Machine Interface & Plant Information System (HMIPIS) HMIPIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC/TCP/IP protocols, etc. shall be provided. Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD common control room. In addition to above, it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR) using OWS placed in CCR. The HMIPIS will include the following as a minimum: Operator Work Station (OWS) in Central Control Room (CCR) and FGD common control room. NTPC shall provide 02 nos. of UPS power feeder per unit from employer's ACDB, for powering FGD OWS located in CCR. Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply. Processing Stations (Servers/Workstations) in redundant configuration including RAM, dual bulk memory etc. Removable storage Media shall be used for historical storage and retrieval and long term storage and retrieval of data. Redundant LAN for communication between various OWS, between OWS and processing stations and OWS. A redundant station-wide LAN for connecting the unitized and common systems of FGD DDCMIS as well for connecting to Employer's Station LAN through firewall. This shall include all cables and accessories required for connecting Contractor's system upto the Employer's systems such as Station LAN, etc. Alternatively, Bidder's standard & proven solution, which is functionally equivalent to redundant system bus and single fault tolerant, shall be acceptable. Adequate measures shall be provided for the security of the DDCMIS including the interface to Employer's Station LAN as detailed at Part-B, subsection DDCMIS. This includes Redundancy in firewall, Connection to Contractor remote service center through VPN technology, etc. Suitable hardware/software for interfacing of FGD DDCMIS with following systems (i) Employer's Station LAN. (ii) Remote diagnostic station for FGD DDCMIS at OEM 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-III-C C&I SYSTEM	PAGE 5 OF 19	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.04.05 2.05.00 2.06.00 2.07.00 2.08.00 2.08.01 2.08.02 2.09.00	DDCMIS vendor shall upgrade/ update all DDCMIS system along with release of DDCMIS system software/ patches, meeting the system software requirements as mentioned in DDCMIS chapter, Part-B, SECTION-VI. This shall include the latest supported OS and its corresponding latest version/ release of DDCMIS system software/ patches. The upgrade/ update shall be carried out in the penultimate year of AMC (In case of one year AMC, third month from the date of commencement of AMC). Any change in hardware required for the same shall also be carried out by the contractor within the contract price. Data Communication System System Bus connecting Control System and HMIPIS. Other bus systems for connecting various systems/subsystems of DDCMIS like Cubicle Bus, Local Bus, I/O Bus (Including Remote I/O Bus) soft links (including those from Field Bus based temperature transmitter) as well as within systems/sub-systems of DDCMIS. All the bus systems shall be redundant except for back plane buses which can be non-redundant. Remote Input/ Output Modules Remote input / output modules and cubicles for locations identified during detailed engineering, in the plant for the signals, which are used for information and Control / Interlock purpose, are to be provided. Annunciation Function The annunciation system shall be built as a part of the control system of the DDCMIS. System programming, diagnostics & documentation facility The programmer station shall be provided for configuration /tuning/structuring of control system and program development /modification of HMIPIS. A Workstation based system documentation facility for automatic generation of system documentation shall be provided to achieve paperless documentation for the project. The diagnostic system shall have elaborate diagnostics facility giving details of fault in I/O modules, other modules and cabinets on OWS in form of display and text messages. Software for determining optimum controller settings for control loops shall be supplied as per subsection DDCMIS, Part-B, Section VI for each unit. Power Supplies			
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-III-C C&I SYSTEM	PAGE 6 OF 19	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
2.10.00	Redundant power supply modules/packs for powering the systems described above in system cabinets with necessary auctioneering and distribution. Cabinets (a.) System cabinets housing electronic modules and power pack supplies of system described above. (b.) Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/SWGR etc. In case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. (c.) Relay cabinet-housing relays for providing contact outputs by control system to other system wherever contacts are used in circuit/scheme of Control supply/power supply of more than 24 V and in cases where the VA burden is more than the VA burden the Output module can drive. Alternatively, these relays can also be mounted in termination/marshalling cabinets also. It may be noted that relays cannot be mounted in system cabinets. (d.) NOT USED (e.) In case DDCMIS supplier can provide system cabinet with suitable partition to create separate marshalling area on the rear side of the system cabinet, ensuring that dust ingression does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage. (f.) The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage. The contractor shall propose suitable design of these cabinets keeping in view, ease of operation and maintenance and minimizing entry of dust to cabinets for Employer's approval. 2.11.00 Warranty and Annual Maintenance Contract Warranty and Annual Maintenance Contract (AMC) for DDCMIS, as per Sub-section IIIC-05 DDCMIS, Part -B, Section-VI of Technical Specification.		
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-III-C C&I SYSTEM	PAGE 7 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.12.00	Representative of OEM shall also be required to be present during Factory acceptance testing (Authorization to shipment test ATST) of respective DDCMIS for testing of finally implemented control system. Logic/HMI implementation for various DDCMIS system shall be done in Uniform way and documents of these shall be furnished in uniform format, as approved by Employer.			
2.13.00	Control System Spare Capacity			
2.13.01	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, DDCMIS shall have spare "Usable" capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:			
2.13.02	10 % spare channel shall be provided in each functional groups for each type of input / output fully wired up to the marshalling/ termination TBs.			
2.13.03	Wired-in "usable" space for 20% modules along with Field Terminal assemblies, PCB/Connectors (if any in the offered system) in each of the system cabinets for mounting electronic modules shall be provided by the Contractor for future use.			
2.13.04	Each controller shall have 20% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type mentioned in clause 2.13.02 & 2.13.03 above, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of controller.			
2.13.05	Ten (10) percent spare relays of each type and rating, mounted and wired in relay cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets. In each of the relay cabinets, 10 % spare terminal blocks shall be provided so that additional relays can be mounted and wired.			
2.13.06	Twenty (20) percent spare terminal blocks in each marshalling cabinets.			
2.13.07	The spare capacity as specified above shall be uniformly distributed throughout all functional groups. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers/ cabinets in the system delivered at site. Further, these additions shall not deteriorate the system parametric requirements like response time / duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement.			
2.13.08	The above mentioned requirements are generally applicable for conventional system. For fieldbus based system refer Annexure IIIC-05K of Part-B for spare			
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-III-C C&I SYSTEM	PAGE 8 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	requirements. In FGs where mix of conventional and fieldbus based system is used, the spare shall be in the respective proportion.			
2.14.00	The contractor has to provide KKS codes for instrument and drives in the P&ID and other related document.			
2.15.00	Output redundancy is applicable for 10% of drives including MOVs, Pneumatic On/Off / Control valves, Electrical breakers etc. distributed in various functional groups. Exact application shall be finalized during detailed engineering.			
2.16.00	Complete wiring / cabling from field devices to panels / MCC and vice versa including conduits / trays / fixtures etc. shall be in bidders scope.			
3.00.00	MEASURING INSTRUMENTS			
	The following shall be provided as a minimum, meeting specification requirements of Sub-section IIIC-2 - MEAS INST of Part-B, Section-VI of Technical Specification.			
3.01.01	Primary instruments like Microprocessor based transmitters employing HART/ Fieldbus protocol, thermocouples & RTDs along with temperature transmitters, pressure/diff. pressure/temperature/flow (Ultrasonic/electromagnetic) transmitter & gauges, flow sensing elements (orifice plates, flow nozzles etc), Ultrasonic, Radar type level transmitters, density meter (Coriolis type. In case the bidder proposes other type of density meter as per the bidder standard and proven practice, the same shall also be acceptable except Nucleonic type density meter), pH analyser, SO₂ analyser, Flue Gas flow transmitter, vibration monitoring system (VMS), analyzers for water system etc. for: (a) FGD plant and other system being provided under the contract, as indicated in enclosed tender diagrams (Part E) of this specification. (b) All Instruments which are Integral to equipment like pumps, motors etc. / skid mounted instruments and are not indicated in enclosed drawings (as applicable) included in relevant sub-sections, but are required for control, monitoring and operation of the equipment/plant/ Systems are to be provided by the Contractor to meet actual system requirements meeting redundancy and other requirements specified under technical specifications subject to Employer's approval. Specification / type of instruments shall be as per standard and proven practice of equipment supplier. However, for temp elements including bearing / winding temp of motors / pumps temp transmitters shall be provided. (c) For Binary and analog inputs required in major equipments of FGD system protection, triple-sensing devices shall be provided. Binary and analog			
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-III-C C&I SYSTEM	PAGE 9 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives etc., triple sensing devices shall be provided. Microprocessor based vibration monitoring system shall be provided for Booster Fans, Limestone Crusher, Milling System and all other equipments operating on 11kV/ 6.6kV/ 3.3kv. The number of bearing locations to be monitored on each equipment shall be as per requirements finalized during detailed engineering but not less than 2 (X and Y direction) bearing locations (except for vertical pumps for which one bearing location may be sufficient). (d) For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided. (e) Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings. 3.01.02 All Pressure Transmitters, Differential Pressure Transmitters and Temperature Transmitters in this package shall be provided based on Fieldbus protocol (complying to specification of Part-B, Section-VI). The protocol of fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval. 3.01.03 Vibration monitoring system panel shall be placed in FGD control room. 3.02.00 All weather analyser panel located in air conditioned containerised room (Portable cabin) or air conditioned analyser room shall be provided for housing analysers except In situ analysers. For balance instruments local panels which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved by Employer during detail engineering. 3.03.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) 3.03.01 CEMS comprising of analysers and associated items for measurement of SO₂, NO_x, CO, CO₂, Mercury, Particulate Matter (dust density), and Stack Flue Gas Flow in Stack emission shall be provided for each unit by the Contractor for stack emission monitoring.			
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-III-C C&I SYSTEM	PAGE 10 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 																																																				
	A) LIST OF FLUE GAS EMISSION ANALYSERS FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) <table border="1"> <thead> <tr> <th>S. No.</th><th>KKS CODE</th><th>DESCRIPTION</th><th>RANGE</th><th>ZONE</th><th>REMARK</th></tr> </thead> <tbody> <tr> <td>1</td><td>HNE10CQ005</td><td>SO₂ in stack emission</td><td>0-250 /0-1500 mg/Nm³ (SELECTABLE)</td><td>CHIMNEY</td><td></td></tr> <tr> <td>2</td><td>HNE10CQ001</td><td>NO_x in stack emission</td><td>0-250 /0-1500 mg/Nm³ (SELECTABLE)</td><td>CHIMNEY</td><td>Refer note-2</td></tr> <tr> <td>3</td><td>HNE10CQ002</td><td>CO₂ in stack emission</td><td>0-25% (Selectable)</td><td>CHIMNEY</td><td></td></tr> <tr> <td>4</td><td>HNE10CQ004</td><td>CO in stack emission</td><td>0-100/ 0-1000 mg/Nm³ (SELECTABLE)</td><td>CHIMNEY</td><td></td></tr> <tr> <td>5</td><td>HNE10CQ003</td><td>Particulate Matter (Dust Density) in stack emission</td><td>0-50 mg/Nm³ / 0 – 300 mg/Nm³ (PROGRAMMABLE)</td><td>CHIMNEY</td><td></td></tr> <tr> <td>6</td><td>HNE10CQ006</td><td>Mercury (Hg) in stack emission</td><td>0 - 35 microgram/Nm³</td><td>CHIMNEY</td><td></td></tr> <tr> <td>7</td><td>HNE10CQ007</td><td>Flue Gas flow at stack</td><td>To be Decided during Detail Engineering.</td><td>CHIMNEY</td><td></td></tr> </tbody> </table> NOTES: - SO₂, NO_x, CO₂ and CO analyser are shown separately for the purpose of input only otherwise SO₂, NO_x, CO₂ and CO analyser may be supplied as a single unit/ Combined Unit (s) meeting specification requirement. - Direct measurement of NO and NO₂ shall be done. Total NO_x values shall be reported as NO₂ i.e. NO_x = NO + NO₂ = NO X 1.53 + NO₂ = NO_x as NO₂. - Oxygen (O₂) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO₂, NO_x and Particulate matter value corresponding to the standard/reference O₂. - CEMS Parameters shall be normalized for temperature, pressure, moisture (applicable in case of wet measurement techniques), etc.. This facility shall be available in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis. - CO₂ Measurement at stack and at instrument end shall be provided in case dilution techniques are used. - Offered CEMS should comply with latest CPCB/regulatory requirement prevailing at the time of award of the contract even if same is not explicitly indicated in the technical specification, without any cost implication to the					S. No.	KKS CODE	DESCRIPTION	RANGE	ZONE	REMARK	1	HNE10CQ005	SO ₂ in stack emission	0-250 /0-1500 mg/Nm ³ (SELECTABLE)	CHIMNEY		2	HNE10CQ001	NO _x in stack emission	0-250 /0-1500 mg/Nm ³ (SELECTABLE)	CHIMNEY	Refer note-2	3	HNE10CQ002	CO ₂ in stack emission	0-25% (Selectable)	CHIMNEY		4	HNE10CQ004	CO in stack emission	0-100/ 0-1000 mg/Nm ³ (SELECTABLE)	CHIMNEY		5	HNE10CQ003	Particulate Matter (Dust Density) in stack emission	0-50 mg/Nm ³ / 0 – 300 mg/Nm ³ (PROGRAMMABLE)	CHIMNEY		6	HNE10CQ006	Mercury (Hg) in stack emission	0 - 35 microgram/Nm ³	CHIMNEY		7	HNE10CQ007	Flue Gas flow at stack	To be Decided during Detail Engineering.	CHIMNEY	
S. No.	KKS CODE	DESCRIPTION	RANGE	ZONE	REMARK																																																
1	HNE10CQ005	SO ₂ in stack emission	0-250 /0-1500 mg/Nm ³ (SELECTABLE)	CHIMNEY																																																	
2	HNE10CQ001	NO _x in stack emission	0-250 /0-1500 mg/Nm ³ (SELECTABLE)	CHIMNEY	Refer note-2																																																
3	HNE10CQ002	CO ₂ in stack emission	0-25% (Selectable)	CHIMNEY																																																	
4	HNE10CQ004	CO in stack emission	0-100/ 0-1000 mg/Nm ³ (SELECTABLE)	CHIMNEY																																																	
5	HNE10CQ003	Particulate Matter (Dust Density) in stack emission	0-50 mg/Nm ³ / 0 – 300 mg/Nm ³ (PROGRAMMABLE)	CHIMNEY																																																	
6	HNE10CQ006	Mercury (Hg) in stack emission	0 - 35 microgram/Nm ³	CHIMNEY																																																	
7	HNE10CQ007	Flue Gas flow at stack	To be Decided during Detail Engineering.	CHIMNEY																																																	
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-III-C C&I SYSTEM	PAGE 11 OF 19																																																

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	Employer. 7. Offered CEMS shall be fully proven for the actual flue gas parameters at stack. Reference list and user feedback of offered CEMS in similar applications shall be furnished to NTPC for review during detailed engineering stage. 8. These are per unit quantities. 9. Analyzers mentioned in S.No. 1 to 7 of the above list of flue gas analyzers for CEMS are not applicable for NSPCL Rourkela (1x250MW) project.			
3.03.02	CEMS analysers/instruments shall be provided with single point bidirectional connectivity over RS-232/RS-485 Modbus Protocol/ Ethernet TCP/IP protocol with Employer's central cloud server for real time data monitoring, remote diagnostics & remote calibration checks, etc., complying with CPCB IT Division document "Protocol for real time (Emission & Effluent) data management from industries version 1.2 (10.6.2015),CPCB Guidelines July-2017 on CEMS or the latest regulatory requirement prevailing at the time of award of the contract. All necessary hardware and software required at instrument end shall be provided by the Contractor. Bidder shall connect analysers/instruments of his scope and provide single point/port for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer. Necessary details like scheme, register addresses of analyzer, etc. shall also be provided by the Contractor for implementation of above. The Contractor shall fully assist NTPC's agency involved in implementation of above connectivity.			
3.03.03	For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor.			
3.03.04	Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for CEMS and Analysers of FGD System.			
3.04.00	SERVICES DURING DEFECT LIABILITY PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD			
3.04.01	The Contractor shall provide an unlimited warranty on all equipments during the Defect liability period. This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost to Employer.			
3.04.02	The Contractor shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of all such items shall be submitted along with Datasheet for Employer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Contractor along with the main equipment consignment. However for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be Contractor's property after expiry of warranty period and shall be taken back.			
3.05.00	SERVICES DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD			
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-III-C C&I SYSTEM	PAGE 12 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
3.05.01	The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for period of three years after the Warranty period.			
3.05.02	The AMC shall cover total maintenance of all Analysers, Sample Handling System, Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items.			
3.05.03	Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares, but has to replenish the same within three months' time or before completion of AMC period whichever is earlier.			
3.05.04	The Contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Contractor's personnel.			
3.05.05	Contractor shall also provide a list of all required AMC spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMC on yearly requirement basis. However for items which have a limited shelf life shall be dispatched in a phased manner during the AMC period. Unused spare/consumable shall be Contractor's property after expiry of AMC period and shall be taken back.			
3.06.00	DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR CEMS AND ANALYSER INSTRUMENTS OF FGD			
3.06.01	Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month. Employer will intimate the contractor two weeks advance notice for start of deputation period.			
3.06.02	After expiry of above six month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMC period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMC period.			
3.07.00	Material Codification of C&I items in NTPC SAP system: a. Contractor to provide detailed catalogue with complete part number of all the instruments, Electronic cards, accessories, JBs, Panels, etc. to Site Erection			
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-III-C C&I SYSTEM	PAGE 13 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	Incharge within one month of supply of item at site for material codification of Main supply and mandatory spares items. b. Contractor to depute his representative for 30mandays at site for codification of materials in NTPC SAP system in phased manner. The detail schedule of the program shall be finalized during commissioning stage at site. c. The material codification of all the C&I items shall be completed before completion of commissioning and handover of system to site.			
3.08.00	Contractor shall provide one no. of Hand held HART calibrator per generating unit.			
4.00.00	PROCESS CONNECTION & PIPING			
	Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section IIIC-3 PCP, Part-B, Section-VI of Technical Specification. All transmitters, switches, temperature transmitters etc shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas. The instruments (electronic transmitters, temperature transmitters, level transmitters, flow transmitters/ flow meter) etc which are not located inside covered building shall be grouped (two or more) and mounted inside instrument racks. In case grouping is not possible and these are to be installed individually, canopy with suitable arrangement shall be provided. The grouping and design of racks/ canopy shall be approved by Employer during detail engineering. Additionally, the same philosophy shall be applicable for switches except for those mounted on pipe and equipment. All electric actuators, pneumatic control valves, JBs ,SOV box and Local control panels which are not installed inside covered building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.			
5.00.00	INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS			
5.01.00	a) All instrumentation cables (twisted & shielded, FRLS PVC insulated and sheathed), data highway / fibre optical cables including prefabricated cables (with plug-in connectors), cables as applicable for direct interconnection of two equipment/ system/ devices in Contractor's scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR etc. (even if they are not in Contractor's Scope.) shall be provided by Contractor on as required basis.			
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-III-C C&I SYSTEM	PAGE 14 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	b) All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition. c) Above cables shall be provided along with necessary laying & termination accessories, hardware etc. meeting requirements specified under Sub-section IIIC-4 INST CABLE, Part -B, Section-VI of Technical Specification. All sub trays along with supporting, connecting hardware etc. required for laying of instrumentation, control, power and other cables etc. up to main cable trays are under Bidders scope. d) Cables required for interfacing FGD DDCMIS with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's scope. e) Cables for connectivity of CEMS signals to Employer's Unit DDCMIS located in unit CER shall be in bidder's scope. f) Junction boxes with requisite terminals shall be provided on as required basis. Grouping, Assignment, Sequence of termination of various field instruments /drive signals (if applicable) to Local junction boxes shall be subject to Employer's approval during detailed engineering.			
6.00.00	CONTROL VALVES & ACTUATORS			
6.01.00	Control valves, actuators and accessories, shall be provided on as required basis for meeting requirements specified under Sub-section IIIC-07 CONTROL VALVE, Part-B, Section-VI of Technical Specification. Specially designed valves/trims to prevent cavitations and limit noise and control outlet velocity, shall be provided.			
6.02.00	Microprocessor Based Electronic Positioner is to be provided on as required basis with all the Control valves and all control dampers being provided by the contractor.			
7.00.00	ELECTRICAL POWER SUPPLY			
	Microprocessor based modular 24V DC power supply system shall be used for powering the control systems including its network devices.			
	24V DC power supply system for DDCMIS based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.			
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-III-C C&I SYSTEM	PAGE 15 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	Contractor shall provide UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as stipulated under Part B, Section VI. Contractor shall provide Mini UPS for each server station as minimum. Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements exceeds 5 KVA, Contractor to provide UPS with Configuration B in place of Configuration C as per Technical Specifications as Part B, Section VI. Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units, MCBs, terminal blocks etc. suitable for application. For detailed requirements of FGD system, refer Sub-Section III-C10, Part B Section VI of technical specifications.			
8.00.00	TYPE TEST REQUIREMENT The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section-IIIC-06 Type Test Requirements, Part-B, Section-VI of Technical Specification.			
9.00.00	TOOLS & TACKLES The Contractor shall furnish a complete new set of all special tools and tackles of reputed make and model which are required for erection, ease in maintenance to have minimum down time, testing and calibration of all the equipments and systems to be provided by the Contractor under this specification for C&I systems.			
10.00.00	Interfacing with Employer's DDCMIS			
10.01.00	Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS/ CHP DDCMIS (under Employer's scope) and FGD DDCMIS (under Contractor's scope) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be provided on as required basis, for implementation of protections and interlocks. Contractor shall provide one Remote Input Output (RIO) per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 130, DO – 130, AI – 50 and AO – 50. NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders per unit from employer's DCDB, for powering RIO panel located in CER. Cabling from DCDB to RIO panel (located in CER) shall be in bidder's scope of supply.			
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-III-C C&I SYSTEM	PAGE 16 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
10.02.00	The Contractor shall provide all assistance to the BOP C&I (in Employer's scope) supplier including co-ordination and flow of required information etc.			
10.03.00	Contractor shall provide complete logics for FGD and associated system such as booster fan blade pitch control, FGD bypass damper control, FGD inlet and outlet gate control etc. FGD OEM shall furnish recommendations, if any, for implementation in employer's DDCMIS for boiler control.			
10.04.00	Contractor to refer the General Layout Plan (GLP) to estimate the distance between FGD control room and Employer's CCR/CER.			
11.00.00	Grounding System Suitable electronic grounding is to be provided by the contractor for all C&I equipments/panels/desk in the scope of the contractor. The exact scheme shall be as finalized during detailed engineering. Also refer Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification.			
12.00.00	Electric Actuators Fieldbus based Non-Intrusive Electrical Actuators with integral starters along with associated accessories etc. shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements specified elsewhere in the Technical specification. For detailed specification refer chapter "Electric Actuator", Part B, Section-VI. These actuators shall comply the common requirements of actuators as specified at clause 2.00.00 and specific requirements of Non-Intrusive fieldbus actuators as specified at clause 4.00.00. Specific requirements of Non-Intrusive hardwired actuators specified in clause no. 3.00.00 are not applicable for this project. For Blade pitch actuators specification clause no. 5.00.00 shall be complied. The protocol of fieldbus based non-intrusive electric actuators shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval. For erection and commissioning of above specified actuators, qualified and experienced engineers of actuator manufacturer shall be deputed at site. After successful commissioning of actuators, minimum one qualified and experienced engineer of main package supplier/ actuator manufacturer shall be continuously available at site up to completion of defect liability period (warranty) of actuators, for troubleshooting and maintenance of actuators and proper interfacing with DDCMIS. Qualified and experienced engineers indicated above shall have expertise in all aspects of non-intrusive actuators along with fieldbus protocol and interfacing with DDCMIS.			
13.00.00	CONTROL DESK, PANELS AND FURNITURES			
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-III-C C&I SYSTEM	PAGE 17 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	Contractor shall provide control desk placed in FGD common control room, Central Control Room (CCR) meeting specification requirements stipulated under sub section IIIC-09 Control Desk, Panels and Furniture PART-B, Section VI of technical specification. Contractor shall provide control desk in CCR of each generating unit, of length 2 meter aesthetically matching with the existing control desk of main plant Central Control Room (CCR) for placing FGD OWS in main plant CCR. The minimum quantity of furniture per generating unit, envisaged in FGD control room is as mentioned below: a) Chair-3 nos. b) Printer table- 1 no c) Computer table- 2 no. d) Key pad- 1 no. e) Locker set -1 no Server rack, PC rack and workstation furniture shall be provided on as required basis. 14.00.00 SCOPE OF SERVICES 14.01.00 The Contractor or his sub-vendor(s) / associate(s) / engineering firm(s) shall have established engineering setup including skilled & experienced manpower, engineering software(s) and other required resources for carrying out basic and detailed engineering of control and instrumentation systems of FGD System. The Control and Instrumentation engineering shall include the following as a minimum. a. Preparation of basic logic / loop diagrams (not just the implementation), I/O list, Drive list, instrument list etc for each of the plant areas of the complete plant including offsite systems based upon the flow schemes / write ups by the OEM's. b. Engineering of power supply system for DDCMIS, Process connection and piping, Control valves etc. c. Instrumentation, cable engineering including preparation of interconnection cable diagram, cable schedule etc. d. The contractor shall deploy certified and experienced engineers in the system design of fieldbus during engineering and commissioning of fieldbus		
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-III-C C&I SYSTEM	PAGE 18 OF 19

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	system. Further, the certified fieldbus engineers shall be available during commissioning of fieldbus instruments and actuators. Protocol will be signed with NTPC site engineer for successful commissioning of fieldbus instruments, actuator along with control system. The name(s) of such certified fieldbus commissioning engineer's shall be approved by Employer and for this the contractor shall submit CV/ experience details of proposed engineers. Further, the contractor shall provide training to employer's personnel on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis. This training shall be provided by certified training agencies of foundation fieldbus/ Profibus foundation and it shall be provided before approval of basic design and engineering document. The block logics shall be in the format as approved by NTPC during detailed engineering stage. For other services refer relevant sections of bidding documents.		
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-III-C C&I SYSTEM	PAGE 19 OF 19

A	Operating Devices & their locations						
		Flue Gas Desulphurization (FGD) and associated systems HMI					
		Units	Qty per unit	Qty-Common	Location	Areas for which Primary Operating Point	Areas for which Secondary Operating Point
	OWS for operation from Main plant Units	No	2		In each Unit Control Room		Absorber and associated systems of respective Unit, Gypsum dewatering handling, Lime Stone preparation & handling and other systems being supplied under the contract.
	OWS for FGD common control room	No		4 (applicable for project with one generating unit/stage) 5 (applicable for project with two generating unit/stage) 6 (applicable for project with three generating unit/stage) 7 (applicable for project with four generating unit/stage)	FGD common control room	Absorber and associated systems of respective Unit, Gypsum dewatering handling, Lime Stone preparation & handling and other systems being supplied under the contract.	
		Flue Gas Desulphurization (FGD) HMI					
		Units	Qty per unit	Qty-Common	Location	Remarks	
	Servers / Information Workstations	No		2	FGD Common Control Room	These shall function in redundant mode. OWS functionality is to be merged with Servers / Information Stations.	
	Programmer cum Documentation Station (Refer note-2)	No		1	FGD Common Control Room		
	Laser jet colour printer (A4 size)	No		1	FGD Common Control Room		
		Hardware for connectivity with Employer's Station LAN					
	Station wide redundant LAN	set		1			

	Hardware Firewall in failover mode	Nos		2			
	Network Management Software	set		1			
	Test Server alongwith requisite Software	set		1			
	Mini UPS (1 no. for each Server Grade Machine)						
	HMIPIS Cabinets: Cabinets for mounting network components & power supply distribution equipment (for each DDCMIS, Station LAN etc.)		On as required basis	On as required basis			
	1. Not used						
	Not used						
	2. (i) In case, separate control system programming device is required, same shall be provided for each DDCMIS system.						
	(ii) For each of the non-DDCMIS based controls being provided for any system, 1 set of programming tool for each such system shall be provided to view & change logic/program/settings.						
	3. Redundant master clock are located in CER. Interconnecting cables shall be on as required basis.						
	4. Software for DDCMIS meeting requirements specified under item "SYSTEM SOFTWARE REQUIREMENTS" sub-section DDCMIS, Part-B, Section-VI of technical specifications shall be on as required basis for all the DDCMIS.						
	5. Data communication system shall be on as required basis. One set of suitable interfaces and links for connectivity between FGD unit LAN, FGD common LAN and employer's Station LAN shall be provided per DDCMIS, as applicable. Cubicles for mounting networking components and power supply distribution equipment shall be provided on as required basis.						
	6. Not used						
	7. Not used						
	8. Not used						
	9. Not used						
	10. Not Used						
	11. Spare Capacity for HMIPIS						
	Each Sub-system HMIPIS shall be provided with capacity to handle at least 30% of each type of peripherals/equipments, additionally, like OWS, printers, etc, over and above already specified, without any additional hardware or software. Further, the Data communication system (including Main system Bus and other bus system), HMIPIS database, Server/Information workstation etc. shall be able to handle 30% extra signals over and above all process as well as calculated (at controller level) signals including the tag nos./process variables being acquired from other DDCMIS sub-system through various links meeting the specification requirements. Usable space of 20% shall also be kept in network panels of each HMIPIS for mounting network components.						
	12. Test server shall be of the same specification, make and model as that of the main DDCMIS server.						

SUB-SECTION-III-D

CIVIL WORKS

CLAUSE NO.	INTENT OF SPECIFICATION			
1.00.00 1.01.01 1.02.00 1.03.00 1.04.00 1.05.00	SCOPE OF CIVIL WORKS Scope of Bidder shall include all Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding, of all the facilities associated with complete Flue Gas Desulphurization system and its auxiliaries, as specified elsewhere in the technical specification. The work to be performed under this specification consists of providing all labour, materials, construction equipment, tools and plant, scaffolding, supplies, transportation, all incidental items not shown or specified, but reasonably implied or necessary for successful completion of the work including Bidder's supervision and in strict accordance with the drawings and specifications. The nature of work shall generally involve earthwork in excavation & deep underground excavation, extensive de-watering, shoring and strutting, sheet piling, back filling around completed structures and plinth protection, paving , disposal of surplus excavated materials, piling, concreting including reinforcement and form work, brick work, fabrication and erection of structural / miscellaneous steel works, inserts, architectural items & finishes such as plastering, painting, flooring, doors, windows & ventilators, glass and glazing, rolling shutters etc., permanently colour coated profiled steel sheeting, anchor bolts, R. C. C. trenches with covers, laying and testing of water pipes, sanitation, water supply, drainage, storm water drains, separate drains and sump pit to collect contaminated water or effluents, damp proofing, water proofing and other ancillary items. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, grounding, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, finishes, false ceiling and complete architectural works, etc. The works covered under the scope of the bidder have to be executed in an operating / under construction power station. The bidder shall take all necessary precautions to protect the entire existing equipments, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason what so ever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/staff from the equipment / facilities of the power station. Analysis, design and preparation of construction drawings for all structure/facilities under the scope of this package and getting the same approved from the owner. Site levelling shall be done by Owner as per the levels specified in GLP in tender document. However, site clearance and minor grading as required is in bidder's scope. For TSTPS there is area marked for FGD which is having slope (i.e. there is grade difference within area). Suitable modification in slope as per bidders requirement with necessary slope protection measures shall be done by bidder.			
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-III-D CIVIL WORKS	PAGE 1 OF 3	

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
2.00.00	CONSTRUCTION FACILITIES The following are also in the Bidder's scope of work: 1. Providing drinking and service water for Bidder's labour, staff and other personnel working for Bidder at the work site and in his staff/ labour colony. He shall install necessary bore wells with associated pumping or water tankers and treatment facilities to supply quality water as per standards. 2. Developing temporary staff colony and labour colony along with fencing etc. Land if required shall be arranged by the Bidder himself. However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises. The area to be allocated to the Bidder shall be discussed & finalized with the bidder after the award, keeping in view the availability of free space & similar requirement of other agencies. 3. Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Owner. 4. Providing all arrangements for the supply of construction water including bore-wells, water tankers etc. 5. Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings 6. Providing all construction equipment, labour and materials. The Bidder shall provide all the tools and tackles required for the work. 7. Development of the pre-assembly and storage yard with fencing, drainage, internal roads, boulder soling, etc. 8. Access roads to his work sites, offices, stores, preassembly / fabrication yard, etc. as required for providing approach/access for men, materials, equipment, cranes, trailor, construction/erection activities etc., what so ever are required by the bidder, shall be constructed and maintained by the bidder. Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided. 9. Area lighting at the construction / erection site, pre-assembly and storage yard, office areas and labour / staff colony. 10. Providing all necessary fire-fighting devices / equipment / fire tender etc. required during the project execution stage. He shall maintain all such equipment / devices in proper working conditions throughout the period of work.			
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-III-D CIVIL WORKS	PAGE 2 OF 3

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC	
	11. Providing first aid facilities at the construction / erection sites, workshops, laboratories, pre-assembly and storage yard and other places of work as per the requirement. 12. The Bidder shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope. 13. Bidder's office, store, workshop, laboratory or any other temporary buildings: The Bidder shall adopt pre-engineered/ pre-fabricated constructions made of steel with single / double skin, insulated for un-insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store workshop, laboratory or any other temporary buildings. Alternatively, bidder can adopt readymade 'Portacabin' or similar construction. Bidder shall ensure that all such constructions are well-engineered, neatly constructed and overall present a pleasing look. The above requirements shall be applicable to his sub-vendors also and bidder shall be responsible for enforcing the same on his sub-vendors. Any other type of construction if proposed by the bidder shall be subject to approval of the owner. However, such construction shall be based on proper design and shall have aesthetic look. 14. Use of ash and ash based products: In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, Bidder shall use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Bidder shall be responsible for enforcing the same on his sub-vendors. 15. Repair & Maintenance Facilities by the Bidder: Bidder shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes, hydra, forklifts, welding equipments, etc.) He will also make arrangements/tie up with manufacturers/ suppliers of such construction plant, equipment & machinery, for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.		
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-III-D CIVIL WORKS	PAGE 3 OF 3

SUB-SECTION-IV

TERMINAL POINTS & EXCLUSIONS

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS 	
1.00.00	TERMINAL POINTS	
1.01.00	FGD	
	The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package.	
1.02.00	Flue Gas Duct	
	(i) Un cleaned Flue Gas For each unit: i) One/two tapping (depending on layout feasibility owing to space limitations and subject to Employer's approval) from the Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employers facilities. ii) One tapping each from the two Flue Gas Duct going towards the existing Chimney (in case of single flue chimney). No load of duct shall be transmitted on the Employers facilities. iii) For Rourkela (1x250 MW) project, terminal points shall be as shown in its tender drawing.	
1.03.00	Equipment Cooling Water	
1.03.01	Normal make up to ECW tank	
	Contractor shall take a tap off suitably from the existing DM normal make up header (DM normal make up pump discharge) available near C-row for meeting the makeup water requirement (maximum quantity 2m³/hr) of ECW system. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.).	
1.03.02	Emergency make up to ECW tank	
	Contractor shall take a tap off suitably from the existing DM Emergency make up header (condensate transfer pump discharge) available near C-row for meeting the emergency make up water requirement (maximum quantity 2m³/hr) of ECW system. The pressure available at TP will be 4 Ksc (gauge) wrt FGL (approx.). For 210 MW, 250 MW units location of existing header is available in BC-bay and pressure shall be 2Ksc (gauge) wrt FGL (approx.)	
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-IV TERMINAL POINTS & EXCLUSIONS
		PAGE 1 OF 3

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS	एनटीपीसी NTPC		
1.04.00	Process Water For process water requirement, Contractor shall take a tap off suitably from the existing blow down header available near FGD area except for coastal projects (Simhadri STPP & Vallur TPP).			
1.05.00	Sea water PT & Desalination plant applicable for Vallur TPP: i) Contractor shall take a tap off suitably from the existing CW blow down header (To CMB) available near the proposed Sea water PT & Desalination plant (as indicated in GLP). ii) Contractor shall terminate the discharge of backwash, cleaning & chemical waste and PT plant sludge into the existing CW blow down header (To CMB) available at 200 meter downstream of intake point to sea water PT & Desalination plant.			
1.06.00	Gypsum Wash Water (Clarified Water) except for Simhadri & Vallur For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row for meeting the water requirement of Gypsum washing. The quantity & pressure available at TP will be 0.015m3/hr /MW and 4Ksc (gauge) wrt FGL (approx.) respectively.			
1.07.00	Potable water Contractor shall take a tap off suitably from the existing potable water supply header (potable water pump discharge) available near C-row for meeting the potable water requirement. The pressure available at TP will be 3Ksc (gauge) wrt FGL (approx.).			
1.08.00	Waste Water FGD waste water including that of LHP/GHP shall be sent to ash slurry sump after lime neutralization. For Rourkela (1x250 MW) project, FGD waste water pipes including LHP/GHP waste water pipes shall be terminated at 5M away from the nearest Mixing tank of Employer in HCSD Silo area. Pressure at terminal point shall be 3kg/cm2(g) at 300mm above FFL. pH shall be 7.0 (approx.) and temperature shall be 50-60°C. Bidder shall indicate the anticipated range of chloride content in the waste water at terminal point.			
1.09.00	Limestone			
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-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS 	
1.10.00	For unloading with Road-Truck Unloading System, entry to truck unloading area. Gypsum Outlet of Gypsum storage silo/shed	
1.11.00	FIRE DETECTION AND PROTECTION SYSTEM (i) Mechanical: Separate Hydrant and spray header (within 100 meter) available in plant area for tapping required for Hydrant and spray system for FGD facilities. Minimum pressure available for hydrant and spray system shall be 8 Kgf/cm².	
1.12.00	All interconnections of matching flanges/expansion joints/piping/ducting etc, between employer supplied equipment/equipment supplied by other contractors and contractor supplied items at terminal points specified above shall, however, be in the scope of FGD Contractor.	
1.13.00	Electrical	
1.13.01	Terminal points of Contractor's electrical scope, applicable for all systems/subsystems described in relevant clauses for SCOPE is given below: i) Employer's HT switchgear ii) Employer 220kV Bus at Switchyard (For TSTPS only)	
1.14.00	Control & Instrumentation a) Employer's marshalling cabinets for hardwired signal exchange with Employer system. b) Employer's station wide LAN switch.	
2.00.00	EXCLUSIONS	
2.01.00	SG and BOP (C&I) DDCMIS	
2.02.00	Station wide LAN	
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-IV TERMINAL POINTS & EXCLUSIONS PAGE 3 OF 3

SUB-SECTION-V

SALIENT DESIGN DATA

CLAUSE NO.	SALIENT DESIGN DATA			एनडीपीसी NTPC	
1.00.00	The Flue Gas Desulphurisation (FGD) System for Sipat-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:				
	Sl. No Item		Guarantee Point	Design Point	
	1	Boiler Load in MW (e)	660	VWO	
	2	Type of Coal	Worst coal	Worst coal	
	3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH	
	4	Coal Flow (T/hr)	511	561	
	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	740 (1143 m ³ /s)	838 (1343 m ³ /s)	
	6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius	
	7	Flue Gas Composition at FGD system inlet:			
	(i)	O ₂ (% v/v wet)	6.130	5.919	
	(ii)	CO ₂ (% v/v wet)	11.137	10.786	
	(iii)	H ₂ O (% v/v wet)	10.633	13.686	
	(iv)	SO ₂ (% v/v wet)	0.082	0.079	
	(v)	N ₂ (% v/v wet)	72.019	69.531	
	(vi)	Inlet SO ₂ (mg/Nm ³ -wet)	2330	2256	
	(vii)	Dust (mg/Nm ³)	50	200	
	(viii)	SO ₃ (ppm)	10.5	10.2	
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-V SALIENT DESIGN DATA	PAGE 1 OF 21

CLAUSE NO.	SALIENT DESIGN DATA																																					
	----- <table><thead><tr><th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr></thead><tbody><tr><td></td><td>(ix) HCl (ppm)-wet</td><td>45</td><td>45</td></tr><tr><td></td><td>(x) HF (ppm)-wet</td><td>12</td><td>12</td></tr><tr><td>8</td><td>SO₂ removal Efficiency (Continuous) (%) (min.)</td><td>95.71</td><td>95.71</td></tr><tr><td>9</td><td>Limestone Consumption (kg/hr) (max.)</td><td>11400</td><td>-</td></tr><tr><td>10</td><td>Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)</td><td>5940</td><td>-</td></tr><tr><td rowspan="2">11</td><td rowspan="2">Chimney Height (m)</td><td>Single Flue</td><td>150</td></tr><tr><td>Twin Flue</td><td>220</td></tr><tr><td colspan="4">* The flue gas volume in Nm³/sec shall be calculated at 101.325 kPa and 273.15 K.</td></tr></tbody></table> -----				Sl. No	Item	Guarantee Point	Design Point		(ix) HCl (ppm)-wet	45	45		(x) HF (ppm)-wet	12	12	8	SO ₂ removal Efficiency (Continuous) (%) (min.)	95.71	95.71	9	Limestone Consumption (kg/hr) (max.)	11400	-	10	Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)	5940	-	11	Chimney Height (m)	Single Flue	150	Twin Flue	220	* The flue gas volume in Nm ³ /sec shall be calculated at 101.325 kPa and 273.15 K.			
	Sl. No	Item	Guarantee Point	Design Point																																		
		(ix) HCl (ppm)-wet	45	45																																		
		(x) HF (ppm)-wet	12	12																																		
	8	SO ₂ removal Efficiency (Continuous) (%) (min.)	95.71	95.71																																		
	9	Limestone Consumption (kg/hr) (max.)	11400	-																																		
	10	Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)	5940	-																																		
	11	Chimney Height (m)	Single Flue	150																																		
			Twin Flue	220																																		
	* The flue gas volume in Nm ³ /sec shall be calculated at 101.325 kPa and 273.15 K.																																					
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-V SALIENT DESIGN DATA	PAGE 2 OF 21																																		

CLAUSE NO.	SALIENT DESIGN DATA			
2.00.00	The Flue Gas Desulphurisation (FGD) System for TSTPS-I&II (2x500 MW + 4x500 MW), Simhadri-I&II (2x500 MW + 2x500 MW) & Vallur (3x500 MW) shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:			
	Sl. No	Item	Guarantee Point	Design Point
	1	Boiler Load in MW (e)	500	VWO
	2	Type of Coal	Worst coal	Worst coal
	3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
	4	Coal Flow (T/hr)	425	458
	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	575 (861 m ³ /s)	642 (996 m ³ /s)
	6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
	7	Flue Gas Composition at FGD system inlet:		
	(i)	O ₂ (% v/v wet)	6.039	5.837
	(ii)	CO ₂ (% v/v wet)	10.753	10.393
	(iii)	H ₂ O (% v/v wet)	12.183	15.122
	(iv)	SO ₂ (% v/v wet)	0.073	0.070
	(v)	N ₂ (% v/v wet)	70.952	68.576
	(vi)	Inlet SO ₂ (mg/Nm ³ -wet)	2079	2010
(vii)	Dust (mg/Nm ³)	50	200	
(viii)	SO ₃ (ppm)	10.5	10.2	
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-V SALIENT DESIGN DATA	PAGE 3 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			
	Sl. No	Item	Guarantee Point	Design Point
		(ix) HCl (ppm)-wet	45	45
		(x) HF (ppm)-wet	12	12
8		SO ₂ removal Efficiency (Continuous) (%) (min.)	95.19	95.19
9		Limestone Consumption (kg/hr) (max.)	7900	-
10		Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)		
		TSTPS	4750	-
		Simhadri	4775	-
		Vallur	5995	-
11		Chimney Height (m)	Single Flue	150
			Twin Flue	200
	* The flue gas volume in Nm ³ /sec shall be calculated at 101.325 kPa and 273.15 K.			
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-V SALIENT DESIGN DATA
PAGE 4 OF 21				

CLAUSE NO.	SALIENT DESIGN DATA																																																																			
3.00.00 A	The Flue Gas Desulphurisation (FGD) System for Bhilai (2x250 MW) & Rourkela (1x250 MW) shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:																																																																			
	<table><tr><th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr><tr><td>1</td><td>Boiler Load in MW (e)</td><td>250</td><td>VWO</td></tr><tr><td>2</td><td>Type of Coal</td><td>Worst coal</td><td>Worst coal</td></tr><tr><td>3</td><td>Ambient air condition</td><td>27° C temp. and 60% RH</td><td>45° C temp. and 60% RH</td></tr><tr><td>4</td><td>Coal Flow (T/hr)</td><td>212</td><td>232</td></tr><tr><td>5</td><td>Gas flow at the FGD inlet when firing respective coal (Nm³/sec)*</td><td>288 (446 m³/s)</td><td>327 (525 m³/s)</td></tr><tr><td>6</td><td>Gas temperature at FGD inlet (deg.C)</td><td>135 degree Celsius</td><td>150 degree Celsius</td></tr><tr><td>7</td><td colspan="3">Flue Gas Composition at FGD system inlet:</td></tr><tr><td>(i)</td><td>O₂ (% v/v wet)</td><td>6.066</td><td>5.862</td></tr><tr><td>(ii)</td><td>CO₂ (% v/v wet)</td><td>10.810</td><td>10.446</td></tr><tr><td>(iii)</td><td>H₂O (% v/v wet)</td><td>11.794</td><td>14.759</td></tr><tr><td>(iv)</td><td>SO₂ (% v/v wet)</td><td>0.072</td><td>0.070</td></tr><tr><td>(v)</td><td>N₂ (% v/v wet)</td><td>71.258</td><td>68.863</td></tr><tr><td>(vi)</td><td>Inlet SO₂ (mg/Nm³-wet)</td><td>2070</td><td>2000</td></tr><tr><td>(vii)</td><td>Dust (mg/Nm³)</td><td>50</td><td>200</td></tr><tr><td>(viii)</td><td>SO₃ (ppm)</td><td>10.50</td><td>10.20</td></tr></table>				Sl. No	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	250	VWO	2	Type of Coal	Worst coal	Worst coal	3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH	4	Coal Flow (T/hr)	212	232	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	288 (446 m ³ /s)	327 (525 m ³ /s)	6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius	7	Flue Gas Composition at FGD system inlet:			(i)	O ₂ (% v/v wet)	6.066	5.862	(ii)	CO ₂ (% v/v wet)	10.810	10.446	(iii)	H ₂ O (% v/v wet)	11.794	14.759	(iv)	SO ₂ (% v/v wet)	0.072	0.070	(v)	N ₂ (% v/v wet)	71.258	68.863	(vi)	Inlet SO ₂ (mg/Nm ³ -wet)	2070	2000	(vii)	Dust (mg/Nm ³)	50	200	(viii)	SO ₃ (ppm)	10.50	10.20
	Sl. No	Item	Guarantee Point	Design Point																																																																
	1	Boiler Load in MW (e)	250	VWO																																																																
	2	Type of Coal	Worst coal	Worst coal																																																																
	3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH																																																																
	4	Coal Flow (T/hr)	212	232																																																																
	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	288 (446 m ³ /s)	327 (525 m ³ /s)																																																																
	6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius																																																																
	7	Flue Gas Composition at FGD system inlet:																																																																		
	(i)	O ₂ (% v/v wet)	6.066	5.862																																																																
	(ii)	CO ₂ (% v/v wet)	10.810	10.446																																																																
	(iii)	H ₂ O (% v/v wet)	11.794	14.759																																																																
	(iv)	SO ₂ (% v/v wet)	0.072	0.070																																																																
	(v)	N ₂ (% v/v wet)	71.258	68.863																																																																
	(vi)	Inlet SO ₂ (mg/Nm ³ -wet)	2070	2000																																																																
	(vii)	Dust (mg/Nm ³)	50	200																																																																
(viii)	SO ₃ (ppm)	10.50	10.20																																																																	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-V SALIENT DESIGN DATA																																																																
PAGE 5 OF 21																																																																				

CLAUSE NO.	SALIENT DESIGN DATA					
	Sl. No Item		Guarantee Point	Design Point		
		(ix) HCl (ppm)-wet	45	45		
		(x) HF (ppm)-wet	12	12		
	8	SO ₂ removal	Bhilai	90.34	90.34	
		Efficiency				
		(Continuous) (%)	Rourkela	97.10	97.10	
		(min.)				
	9	Limestone	Bhilai	3800	-	
		Consumption				
		(kg/hr) (max.)	Rourkela	4100		
	10	Unit Auxiliary Power Consumption				
		(KW) for complete scope of work for the project (max.)				
			Bhilai	2750	-	
		Rourkela	1900 without booster fans	-		
			2750 with booster fans			
11	Chimney Height (m)	Bhilai	Single Flue	150		
			Twin Flue	200		
* The flue gas volume in Nm ³ /sec shall be calculated at 101.325 kPa and 273.15 K.						

CLAUSE NO.	SALIENT DESIGN DATA			एनडीपीसी NTPC
3.00.00 B	The Flue Gas Desulphurisation (FGD) System for Muzaffarpur-II (2X195 MW) shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:			
	Sl. No Item		Guarantee Point	Design Point
	1	Boiler Load in MW (e)	195	VWO
	2	Type of Coal	Worst coal	Worst coal
	3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
	4	Coal Flow (T/hr)	197	220
	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	258 (389 m ³ /s)	298 (465 m ³ /s)
	6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
	7	Flue Gas Composition at FGD system inlet:		
	(i)	O ₂ (% v/v wet)	6.219	6.005
	(ii)	CO ₂ (% v/v wet)	9.822	9.479
	(iii)	H ₂ O (% v/v wet)	13.630	16.527
	(iv)	SO ₂ (% v/v wet)	0.044	0.042
	(v)	N ₂ (% v/v wet)	70.286	67.929
	(vi)	Inlet SO ₂ (mg/Nm ³ -wet)	1257	1215
	(vii)	Dust (mg/Nm ³)	50	200
	(viii)	SO ₃ (ppm)	10.50	10.20
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 7 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			
	Sl. No	Item	Guarantee Point	Design Point
		(ix) HCl (ppm)-wet	45	45
		(x) HF (ppm)-wet	12	12
	8	SO ₂ removal Efficiency (Continuous) (%) (min.)	95.00	95.00
	9	Limestone Consumption (kg/hr) (max.)	2200	-
	10	Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)	2145	-
	11	Chimney Height (m)	Single Flue	150
			Twin Flue	200
	* The flue gas volume in Nm ³ /sec shall be calculated at 101.325 kPa and 273.15 K.			
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-V SALIENT DESIGN DATA	PAGE 8 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			एनटीपीसी NTPC
4.00.00	Chimney			
4.01.01	A "wet chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor. Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a wet stack without reheating of the flue gas.			
4.01.02	Single-flue or twin-flue chimney shall be provided. The flue gas emission point above the plant grade level shall be as per the salient design data for the respective projects as indicated in the previous clauses.			
4.01.03	The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation.			
4.01.04	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 (ASTM B575, UNS N10276) alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done by explosion bonding or hot rolling to achieve the required quality as per ASTM B 898-11.			
	Alternatively, Contractor can also provide chimney of 8 mm thick (minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness, which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening. In such a case, Contractor/Lining supplier shall provide a ten (10) year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system.			
	Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Borosilicate Lining and insulated for Titanium/C276 cladding irrespective of surface temperature.			
4.01.05	The top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner.			
4.01.06	External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation.			
4.01.07	The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc.			
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-V SALIENT DESIGN DATA	PAGE 9 OF 21

CLAUSE NO.	SALIENT DESIGN DATA																	
4.01.08	The chimney liner & duct shall be designed & sized considering the following requirements as a minimum. <table><tr><th>SN</th><th>Item</th><th>Chimney Sizing Condition</th></tr><tr><td>1</td><td>Boiler Load in MW (e)</td><td>TMCR Worst Coal (Guarantee Point)</td></tr><tr><td>2</td><td>Gas flow at Chimney Inlet (M³/sec)</td><td>To be worked out considering Guarantee Point condition</td></tr><tr><td>3</td><td>Gas temperature at Chimney Inlet (deg. C)</td><td>To be worked out considering Guarantee Point conditions</td></tr><tr><td>4</td><td>Flue Gas velocity (m/s) inside Chimney</td><td>< 16.8 for Titanium / C-276 Lining < 18.3 for Borosilicate Lining</td></tr></table>			SN	Item	Chimney Sizing Condition	1	Boiler Load in MW (e)	TMCR Worst Coal (Guarantee Point)	2	Gas flow at Chimney Inlet (M³/sec)	To be worked out considering Guarantee Point condition	3	Gas temperature at Chimney Inlet (deg. C)	To be worked out considering Guarantee Point conditions	4	Flue Gas velocity (m/s) inside Chimney	< 16.8 for Titanium / C-276 Lining < 18.3 for Borosilicate Lining
SN	Item	Chimney Sizing Condition																
1	Boiler Load in MW (e)	TMCR Worst Coal (Guarantee Point)																
2	Gas flow at Chimney Inlet (M³/sec)	To be worked out considering Guarantee Point condition																
3	Gas temperature at Chimney Inlet (deg. C)	To be worked out considering Guarantee Point conditions																
4	Flue Gas velocity (m/s) inside Chimney	< 16.8 for Titanium / C-276 Lining < 18.3 for Borosilicate Lining																
4.02.00	A wet stack study shall be performed by the Contractor for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed. A wet stack model study shall consist of the following: (i) Condensation calculations (ii) Minimum 1:12 scale physical flow model for liquid collector design (iii) Computational flow model for plume downwash analysis (iv) Physical or computational flow model for CEMS elevation flow performance																	
4.03.00	Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), include the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to rain out to the ground before evaporation.																	
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-V SALIENT DESIGN DATA	PAGE 10 OF 21														

CLAUSE NO.	SALIENT DESIGN DATA			
5.00.00	LIMESTONE CHARACATERSTICS			
	Chemical Analysis(% by mass)			
	1.	CaO	%	47-51.0*
	2.	MgO	%	0.9-2.0
	3.	Fe ₂ O ₃	%	0.45-1.0
	4.	Al ₂ O ₃	%	1.19-2.1
	5.	Si ₂ O ₃	%	2.1-4.5
	6.	Mn ₂ O ₃	%	<0.12
	7.	P ₂ O ₅ ,	%	Traces
	8.	Cl ₂	%	<0.015
	9.	Na ₂ O	%	<0.16
	10.	K ₂ O	%	<0.01
	11.	TiO ₂	%	<0.02
	12.	Total Sulphur	%	<0.1
	13.	LOI	%	39.0-41.3
	Physical properties			
	1	Bond Index	kWh/sht	13
	2	Granule size		Medium
	Note: 1. *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO₃ content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaCO₃ content of 79%. 2. For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m³. However for torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m³. For gypsum, the bulk density shall be taken as 900 kg/m³			
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-V SALIENT DESIGN DATA	PAGE 11 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			
6.00.00	for volumetric computation and 1250 kg/m³ for torque, drive & structural load requirements. 3. For the purpose of sizing of equipments and guarantee, MgCO₃ shall be considered as unreactive dolomitic form. AIR CONDITIONING SYSTEM GENERAL REQUIREMENTS 1. All equipments shall be located indoor unless otherwise agreed to by the Employer. The equipment and layout shall generally be in accordance with the General Layout Plant drawings. 2. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments. 3. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance. 6.01.00 DESIGN PHILOSOPHY FOR AIR CONDITIONING 1. Design ambient conditions for all air conditioning system shall be as per Appendix-A. 2. All equipments of Air Conditioning system shall be designed for continuous duty. 3. All air conditioned areas shall be maintained at 24 deg. C $\pm$ (plus or minus) 1 deg. C and relative humidity of 50% $\pm$ (plus or minus) 5%. 4. The fresh air quantity for air-conditioned areas of FGD Control Room etc. shall be 0.45 M³/minutes/person or 1.5 air change per hour whichever is greater. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units. 5. Lighting load shall be minimum 2 Watts/Sq. feet. 6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum). 7. In Air conditioning system for FGD Control Room, return air shall be routed back to AHU room through plenum space. 8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.			
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-V SALIENT DESIGN DATA	PAGE 12 OF 21	

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC		
6.02.00 6.02.01	9. Soft water make up (if required) for complete air conditioning system shall be provided by the bidder in-line with terminal point specified in technical specification. 10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. 11. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec. 12. Requirement of Underdeck Insulation (for A/C area) Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area. ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area. iii) Underneath the ceiling of AHU room located below the A/C area or exposed to Atmosphere. 13. AHU's shall be provided with two stage of filtration i.e. pre and fine filter. All fresh air supply shall also be filtered using pre and fine filter. 14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area. 15. For areas like FGD control room where load is more than 15TR, direct expansion (D-X) type condensing unit (with AHU) shall be provided. For other areas where air conditioning requirement is 5-15 TR ductable split/package A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided. 16. Insulation for supply and return air ducts: Supply and return ducts shall be insulated. All types of Insulation used for HVAC application shall be CFC/HCFC free. REDUNDANCY OF EQUIPMENTS Redundancy of various A/C system equipments shall be as follows: a) FGD Control Room Building i) Air Cooled condensing units Air conditioners: 2X100% ii) AHU (with VVFD): 2 X 100% b) 100% standby shall be provided for area served by Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners for all other control rooms covered in the scope of this package. c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.			
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-V SALIENT DESIGN DATA	PAGE 13 OF 21	

CLAUSE NO.	SALIENT DESIGN DATA			एनटीपीसी NTPC
6.03.00	DESIGN PHILOSOPHY – Ventilation System 1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows: i) For all evaporative cooled areas - 8 ii) General areas - 20 iii) MCC / Switchgear rooms and Battery rooms & other areas where gaseous fumes/ vapours are generated - 30 2. However in areas producing lot of heat, temperature shall be the criteria as follows:- a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas. b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas. Note: Dry bulb temperature during summer season mentioned in clause 7.01.00 (Appendix-A) Sub- section V, Part-A shall be considered as Design Ambient Temperature for above. The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected. 3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers. All other areas like pump house, Blower/compressor house (if any), etc shall be positively ventilated by a combination of supply air fan and exhaust air fan. Supply air fan catering for electrical areas (MCC & Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. For Positive ventilation CFM of exhaust air shall be 60% of CFM required for supply air. Similarly for negatively ventilated area, CFM of supply shall be 60% of total CFM exhaust. 4. All the equipments of Ventilation system shall be designed for continuous duty. 5. The supply air ducts of evaporative type ventilation system entering into switchgear room, cable galleries etc. shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating). Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to			
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-V SALIENT DESIGN DATA	PAGE 14 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			
	operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder. 6. Circulating water Capacity for Air washer units shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec. 7. For pumps, continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range. For fans, compressors and blowers continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand at the design duty point. 8. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.			
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-V SALIENT DESIGN DATA	PAGE 15 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			
	Appendix-A Outside Design Ambient condition to be considered for Air Conditioning system and Ventilation System for various project/station are as under.			
	Location	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
	TSTPS Stg-I & II (2x500+4x500)	Summer	43	27
		Monsoon	34	28
		Winter	11	5
	Simhadri Stg-I & II (2x500+ 2x500)	Summer	41.5	27
		Monsoon	38	27.5
		Winter	19	14.44
	Sipat Stg-I (3x660)	Summer	43.9	25.6
		Monsoon	38.4	27.8
		Winter	15	10
	KBUNL Muzaffarpur TPS (2x195)	Summer	43	27.5
		Monsoon	38	29.5
		Winter	7	5.8
	NTECL Vallur (3x500)	Summer	43.5	26.5
		Monsoon	38	27.5
		Winter	22	18
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-V SALIENT DESIGN DATA PAGE 16 OF 21

CLAUSE NO.	SALIENT DESIGN DATA				
7.00.00 7.01.00 7.02.00					
	NSPCL Bhilai (2x250)	Summer	43.3	25	
		Monsoon	33.3	28.3	
		Winter	10	7.2	
	NSPCL Rourkela (1x250)	Summer	43	25.6	
		Monsoon	30.6	27.8	
		Winter	10	7.2	
	Fire Detection and Protection System				
	General Design Criteria				
	All major equipment/ system components in the entire fire protection & detection system shall have the approval from one of the following:				
a) Underwriters laboratories of USA					
b) LPCB-UK					
c) VDS					
d) BIS (for the approval of pumps and valves as applicable)					
e) FM- USA					
However design and installation of complete system and requirements shall be approved by TAC accredited professional(s)-India.					
Hydrant System					
Design philosophy (minimum requirement)					
i) Category of Hazard and minimum terminal pressure shall be as TAC norms.					
ii) All the landings of staircases, building, and other multi-storied structures of the plant shall be provided with hydrant landing valves.					
iii) Each of the landing valves and external hydrant valves associated with FGD area shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines.					
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-V SALIENT DESIGN DATA	PAGE 17 OF 21

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC		
7.03.00	For landing valves of various buildings of FGD area, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines. iv) The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC hump pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification. HVW & MVW Spray System Design Philosophy (Minimum Requirements) i) Design discharge density shall be as per the rules of TAC and/ or NFPA standards. ii) Deluge valve along with trims like pressure gauge, water motor gong, etc. shall be UL/FM or equivalent approved / listed. The deluge valve (auto resetting type) assembly shall consist of accessories such as water motor gong, alarm test valves, drip/drain valves, strainers for these valves, hydraulic releasing system, solenoid valves, etc. Further, the design features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed. iii) A strainer ('Y' type) be provided at upstream of deluge valve. iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock. v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors. vi) Each of the outdoor deluge valve and accessories shall be provided with housing. vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel when the system is selected in remote manual mode. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel.			
7.04.00	Fire Detection, Alarm and Control System Design Philosophy (Fire Alarm and Detection System) i. The addressable type panels at FGD Control equipment rooms shall receive signal from sensors from various areas/ equipments of the respective units. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall			
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-V SALIENT DESIGN DATA	PAGE 18 OF 21

CLAUSE NO.	SALIENT DESIGN DATA									
	activate a hooter/sounder in each of the area provided with fire/smoke detection system ii. Alarms from the FGD fire alarm panel shall be repeated simultaneously in repeater panel at Fire station. Also the fire alarms of this area has to be communicated to the main plant Fire alarm control panel through potential free contacts. iii. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of Fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc. iv. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels. v. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.									
8.00.00	Compressed Air System DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE 1. All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment. 2. The compressors and Air Drying plants shall operate under the following ambient conditions. i. Minimum temperature : 10 deg.C ii. Maximum temperature : 50 deg. C iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH iv. Height above MSL (m) : Refer Chapter "Project Information" 3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.									
8.01.00	Selection of Capacity of Air Compressor a) Air Compressor Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipments/plant/systems to be supplied by the Contractor for FGD Plant as follows:- <table><tr><th>Sl. No.</th><th>Continuous Requirement</th><th>Quantity (in NM³/min)</th></tr><tr><td colspan="3"></td></tr></table>				Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)			
Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)								
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-V SALIENT DESIGN DATA	PAGE 19 OF 21						

CLAUSE NO.	SALIENT DESIGN DATA	
	1. Instrument air requirement for FGD plant (Continuous) 2. Service air requirement for FGD plant 3. Total Air requirement 4. Capacity of air compressor = = A B A+B 2(A+B) Notes: While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air and service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air and service air, if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4. - The capacity of air drying plant shall be equal to the capacity of the individual air compressors. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air". - Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm² (g) or more as per the requirement of Contractor. - The discharge pressure of compressor shall be minimum 8.5 Kg/cm² (g). - The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature. - The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C. - Noise level shall not exceed 85 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. - Parallel operation of compressors shall be possible without any undue vibration and noise. - The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors. - All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.	
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-V SALIENT DESIGN DATA PAGE 20 OF 21

CLAUSE NO.	SALIENT DESIGN DATA			एनटीपीसी NTPC
9.00.00 9.01.00	LIMESTONE AND GYPSUM HANDLING PLANTS Refer Part-B section-I M6 of technical specification.			
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-V SALIENT DESIGN DATA	PAGE 21 OF 21	

SUB-SECTION-VI

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

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

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

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

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>TSTPS-I&II (6X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,525,692/- (INR Two Million Five Hundred Twenty Five Thousand Six Hundred Ninety Two only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 222,806/- (INR Two Hundred Twenty Two Thousand Eight Hundred Six only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 5 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>SIMHADRI-I&II (4X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,706,327/- (INR Two Million Seven Hundred Six Thousand Three Hundred Twenty Seven only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 146,574/- (INR One Hundred Forty Six Thousand Five Hundred Seventy Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PAGE 6 OF 27				

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>SIPAT-I (3X660 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 3,121,134/- (INR Three Million One Hundred Twenty One Thousand One Hundred Thirty Four only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 124,783/- (INR One Hundred Twenty Four Thousand Seven Hundred Eighty Three only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PAGE 7 OF 27				

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>VALLUR (3X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,891,630/- (INR Two Million Eight Hundred Ninety One Thousand Six Hundred Thirty only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 237,570/- (INR Two Hundred Thirty Seven Thousand Five Hundred Seventy only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PAGE 8 OF 27				

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

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>MTPS (2X195 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 1,703,396/- (INR One Million Seven Hundred Three Thousand Three Hundred Ninety Six only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 204,848 /- (INR Two Hundred Four Thousand Eight Hundred Forty Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PAGE 10 OF 27				

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>ROURKELA (1X250 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 1,659,337/- (INR One Million Six Hundred Fifty Nine Thousand Three Hundred Thirty Seven only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,425,863/- (INR Thirty Million Four Hundred Twenty Five Thousand Eight Hundred Sixty Three only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 215,708/- (INR Two Hundred Fifteen Thousand Seven Hundred Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 11 OF 27

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

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

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

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	mg/Nm³ at absorber outlet measured over a period of 24 hrs continuous operation. Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer. (xii) Availability of FGD Plant The Contractor shall guarantee the maximum availability of FGD Plant for the range of coal and limestone specified inline with the requirements stipulated in clause 7.00.00 of this Sub-Section (xiii) Air Conditioning System A. Following shall be demonstrated at Shop 1) Capacity and static pressure of AHU fans at its rated duty point. B. Following shall be demonstrated at Site 1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building. 2) Guaranteed room conditions during summer for all the Air conditioned areas. 3) Vibration and noise level of condensing units & centrifugal fans of AHUs. (xiv) Ventilation System A. Following shall be demonstrated at Shop 1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system. 2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system. B. Following shall be demonstrated at Site 1) Vibration & Noise level of centrifugal fans & pumps of UAF units. (xv) Compressed Air System a) Following shall be demonstrated at shop: i) Capacity and discharge pressure of each air compressor. b) Following shall be demonstrated at site: i) Dew point of air at the outlet of air drying plants of air compressor.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 15 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC												
	ii) Pressure drop across air drying plant. iii) Vibration and noise level of air compressors, blowers of air drying plant (if applicable) (xvi) Equipment Cooling Water System i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site. ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site. (xvii) Clarification Plant (Applicable for Simhadri) a) Each clarifier unit of PT-CW system shall be guaranteed for an effluent capacity of not less than 280 Cu.M/hr meeting the effluent quality as mentioned below. b) Effluent quality at the outlet of clarifiers (PT-CW system) shall be guaranteed for the following : i) Organic Matter : Less than 0.05 mg/litre (see note below) ii) Iron Content : Less than 0.3 mg/litre iii) Turbidity : Less than 10 NTU Note: Organic matter shall be tested as per $KmnO_4$ method. c) Each clarifier shall be tested to demonstrate the above mentioned Guarantees at site under P&G test. In addition, demonstration of satisfactory working of all the clarifiers, its drives, scrapper mechanism, operation of sludge blow-off etc, shall be demonstrated by Contractor. (xviii) SWRO/RO Plant (Applicable for Vallur) A) Reverse Osmosis (2nd Stage RO) Plant: a) Permeate Water quality at the outlet of RO plant shall be as follows:<table><tr><th>SI No</th><th>Parameter</th><th>Unit</th><th>Design Value</th></tr><tr><td>a)</td><td>pH</td><td></td><td>7.5 to 8.5</td></tr><tr><td>b)</td><td>TDS</td><td></td><td>≤ 350 ppm at 36 °C</td></tr></table>				SI No	Parameter	Unit	Design Value	a)	pH		7.5 to 8.5	b)	TDS		≤ 350 ppm at 36 °C
SI No	Parameter	Unit	Design Value													
a)	pH		7.5 to 8.5													
b)	TDS		≤ 350 ppm at 36 °C													
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 16 OF 27												

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	b) Net permeate flow rate from each RO train shall be guaranteed. Net Permeate flow rate from each SWRO train shall not be less than 225 Cum/hr c) Availability factor of each RO train /plant shall be not less than 95%. d) For the design water quality and the permeate water capacity guaranteed, undiminished overall recovery of RO plant shall be 85% upto the end of 3 years of operation without any replacement of membrane elements. e) Noise & Vibration level of rotating equipments of RO Plant such as High Pressure (2nd Stage RO unit) Pumps & RO plant (2nd Stage RO unit) feed pumps. f) Filtration capacity thru Cartridge filters (2nd Stage RO) shall not be less than gross capacity of each RO train meeting the effluent quality. g) Daily Consumption of Acid and Alkali required for pH Control of each RO unit. <u>B) Sea Water Reverse (SWRO) (1st Stage) Osmosis Plant & associated System</u> a) Water quality at feed to SWRO plant (at the outlet of cartridge filters of SWRO Plant) shall be:- i) SDI shall be limited to 3 ii) Turbidity (NTU) shall be limited to 1 iii) S & DSI shall be limited to 0.5 iv) pH shall be in the range of 6.5 to 7.0 v) Chlorine (ppm) shall be limited to Nil b) Net permeate flow rate from each SWRO (1st RO) train shall be guaranteed such that the net Permeate flow rate from each RO train(2nd Stage) shall not be less than 225 Cum/hr. However, Net permeate flow rate from each SWRO (1st RO) train shall not be less than 275 m3/hr . c) Availability factor of each SWRO(1st Stage) train shall not be less than 95%. d) For the design water quality and the permeate water capacity guaranteed, undiminished overall recovery of SWRO plant shall be 35% up to the end of 3 years of operation without any replacement of membrane elements. e) Noise & Vibration level of rotating equipments of SWRO (1st Stage) Plant such as High Pressure Pumps.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 17 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	f) Performance of Cleaning, Flushing System shall be demonstrated by the Contractor. g) Performance of backwashing, air scouring of filters, Cleaning and/or Flushing operation for membranes etc. shall be demonstrated by the Contractor. h) Filtration Capacity of Cartridge filters and Dual media filters shall be guaranteed meeting the effluent quality and the same shall not be less than specified capacity. i) The pumps shall be guaranteed to operate satisfactorily without cavitation, pitting, excessive vibration or noise in single pump operation (one pump running) and/or in parallel operation with other pumps or and when starting or shutting down a pump while other pump(s) is/are in operation. j) Current, Voltage, Motor input Power, Frequency, Speed, Bearing / Motor winding Temperature, Vibration and noise level of pumps, blowers and their drives and parallel operation of pumps & blowers shall be demonstrated at site as a part of Performance & Guarantee test. k) Daily Consumption of Acid and Alkali required for pH Control of each RO unit C) Ultrafiltration System: Permeate Water quality at outlet to UF plant shall be:- i) SDI shall be limited to 3 ii) Turbidity (NTU) shall be limited to 1.0 iii) Net permeate flow rate from each Ultra-filtration Plant shall be guaranteed. Net Permeate flow rate from Ultra-filtration Plant shall not be less than 1700 Cum/hr. iv) For the design water quality and the permeate water capacity guaranteed, undiminished overall recovery of UF Plant shall be 92% up to the end of 5 years of operation with replacement guarantee of membrane elements. vi) Availability factor of each UF plant delivering net permeate flow shall be not less than 95%. vi) Noise & Vibration level of rotating equipments of plant. vii) Performance of Cleaning, Flushing, Backwashing System shall be demonstrated by the Contractor. viii) Filtration Capacity of Ultra-filtration System shall be guaranteed meeting the effluent quality and the same shall not be less than specified capacity.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 18 OF 27	

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

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

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

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

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

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

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	f) Submittal of the report and subsequent approval by the engineer shall be required for completion. Test reports shall be submitted in booklet form showing all fields tests performed to adjust each component and all field tests performed to prove compliance with specified / guarantee parameters. g) In general, each UF/SWRO skid will be subjected to the performance test in sequence. However, verification some guarantee parameters shall be carried out in one skid as described in this Chapter/ Subsection. h) For PG test of UF/SWRO plant, the water analysis to be carried out during the trial and performance test runs shall be in compliance with ASTM D 4195 – “Standard Guide for Water Analysis for Reverse Osmosis Applications” and ASTM-Standard Test Methods listed in this guide or equivalent methods of the AWWA/APHA Standard Methods for the United States Environmental Protection Agency (USEPA). Also following standard procedures as to Annual Book of ASTM Standards – Section 11 shall be used during the Performance Testing of the SWRO system. ▪ D 3739 – Calculation and Adjustment of the Langelier Saturation Index for RO ▪ D 4189 – Silt Density Index (SDI) of Water ▪ D 4194 – Operating Characteristics of RO Devices ▪ D 4195 – Water Analysis for RO Application ▪ D 4516 – Standardizing RO Performance Data ▪ D4582–Calculation and adjustment of the Stiff and Davis Stability Index for RO ▪ D 4692 – Calculation and Adjustment of Sulfate Scaling Salts for RO ▪ D 4993 – Calculation and Adjustment of Silica Scaling for RO i) During testing the following readings are to be taken every two (2) hours during the test period. 1) <u>At Clarifier inlet & outlet:</u> Flow, pH, turbidity, TSS, KMnO₄ number 2) <u>At Filter (DMF) inlet & outlet::</u> - Flow, pH, turbidity, SDI, residual chlorine, KMnO₄ number 3) Feed Water inlet to UF Skids: Flow, Pressure, Temperature, Conductivity, pH, Turbidity, TDS, SDI, residual chlorine, KMnO₄ number & ORP			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 26 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	4) Permeate flow from UF Skids: Flow, Pressure, Conductivity, pH, Turbidity, TDS, SDI, ORP, residual chlorine, KMnO4 number 5) <u>Feed Water inlet to SWRO Skids</u>: Flow, Pressure, Temperature, Conductivity, pH, TDS, SDI, residual chlorine, ORP & Boron 6) <u>Permeate flow from SWRO Skids</u>: Flow, Pressure, Conductivity, pH (before & after alkali dosing), TDS, SDI, ORP, Boron and LSI 8) Chemical Consumption for pre-treatment, UF system, RO conditioning and Post treatment j) Log sheets required for noting down readings/results of various tests shall be prepared during formal approval of PG test procedure. k) The test shall be carried out for each UF/SWRO skid, in sequence. l) Considering the plant water requirement which may vary, all the trains/ exchangers/ equipments may not be possible to be tested continuously one after another. However tests shall be completed for complete system /equipments within one year from the initial operation of last UF/SWRO unit as the case may be. m) Should the PG test of UF/SWRO plant be affected or interrupted for reasons related to reliability or performance of equipment, the test shall be stopped and repeated in full when faults have been remedied by implementing adequate solutions. n) The test run for shall be for a minimum of 72 hours for each train / skid /Stream as the case may be. The test shall be carried out for each train / skid in sequence.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 27 OF 27	

SUB-SECTION-VII

MANDATORY SPARES

CLAUSE NO.	MANDATORY SPARES	एनटीपीसी NTPC		
1.00.00	GENERAL The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:			
1.01.00	MANDATORY SPARES a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish total population of each item for the project in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The Employer reserves the right to buy any or all the mandatory spare parts. e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.			
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-VII MANDATORY SPARES	PAGE 1 OF 82	

CLAUSE NO.	MANDATORY SPARES			
1.02.00	f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.			
	g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.			
1.03.00	RECOMMENDED SPARES			
	a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.			
1.04.00	b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.			
	START-UP & COMMISSIONING SPARES			
1.04.00	a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.			
	The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:			
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-VII MANDATORY SPARES	PAGE 2 OF 82

CLAUSE NO.	MANDATORY SPARES			
2.00.00	The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.			
3.00.00	All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccators packs as necessary.			
4.00.00	All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.			
5.00.00	The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.			
6.00.00	Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.			
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.			
8.00.00	The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/equipments covered under the Contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.			
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.			
10.00.00	In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.			
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall			
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-VII MANDATORY SPARES	PAGE 3 OF 82

CLAUSE NO.	MANDATORY SPARES 		
	guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.		
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-VII MANDATORY SPARES	PAGE 4 OF 82

CLAUSE NO.	MANDATORY SPARES		
	Mandatory Spares List (For Each Project)		
	Sl. No.	Description	Nos. / Sets for Each Project
	1.01.00	<u>Booster Fans</u>	
		1. Fan assembly (excluding fan body)	1 no.
		2. Booster fan motor	1 no.
		3. Fan bearings	1 set
		4. Booster fan motor bearings	1 set
		5. Spares for blade bearing Assembly	
		5.1 Bearings	2 sets
		5.2 'O' rings	2 sets
		5.3 Bushes	2 sets
		5.4 Metallic rings	2 sets
		5.5 Intermediate piece (if applicable)	1 sets
		6. Lube Oil / Hydraulic Oil system	
		6.1 Pump assembly	1 nos. of each type
		6.2 Pump motor	1 no. of each type & rating
		6.3 Pressure regulator	2 nos.
		6.4 Filters	2 nos.
		6.5 Coupling between oil pump & motor	1 nos.
		7. Fan Blades	1 sets
		8. Coupling between Fan & Motor	1 sets.
		9. Hydraulic servomotor	1 no.
	1.02.00	<u>Gates in Flue Gas System</u>	
		1. Seals	1 set of each type (Set means complete
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-VII MANDATORY SPARES PAGE 5 OF 82

CLAUSE NO.	MANDATORY SPARES		
			replacement for one gate)
	2.	Actuator	1 no. of each type & rating
	3.	Expansion joint	1 number for each type and size
	1.03.00	Not Used	
	1.04.00	<u>Absorber</u>	
	1.	Absorber Spray/Oxidation nozzles	10% of each type and size
	2.	Absorber Mist Eliminator Washing Nozzles	10% of each type and size
	3.	Absorber Mist Eliminator	5% of each type and size/configuration
	1.05.00	<u>Oxidation Air Blower</u>	
	1.	Impeller Assembly	1 no.
	2.	Bearings	1 no. of each type
	1.06.00	<u>Agitators</u>	
		(A) (For Absorber Oxidation Tank & Aux. Absorbent/Emergency tank),	
	1.	Impeller Assembly	1 no. of each type and size
	2.	Bearing Assembly	1 no. of each type and size
	3.	Motor	1 no. of each type and size
	4.	Belt and Pulley (If applicable)	1 no. of each type and size
	5.	Gear Box Assembly (If Applicable)	1 no. of each type and size
	6.	Agitator shaft assembly	1 no. of each type and size
	7.	Shaft seal	1 no. of each type and size
	8.	Complete Agitator assembly	1 no. of each type and size
		(B) AGITATORS for Mill Separator Tank, Limestone Slurry Preparation Tank, Secondary hydrocyclone feed, Waste	
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-VII MANDATORY SPARES
			PAGE 6 OF 82

CLAUSE NO.	MANDATORY SPARES																																															
	water, Filtrate tank and any other tank provided with agitators) <table><tr><td>1.</td><td>Impeller Assembly</td><td>1 no. of each type</td></tr><tr><td>2.</td><td>Bearing Assembly</td><td>1 no. of each type</td></tr><tr><td>3.</td><td>Motor</td><td>1 no. of each type</td></tr><tr><td>4.</td><td>Belt and Pulley (If applicable)</td><td>1 no. of each type</td></tr><tr><td>5.</td><td>Gear Box Assembly (If Applicable)</td><td>1 no. of each type</td></tr><tr><td>6.</td><td>Agitator shaft assembly</td><td>1 no. of each type and size</td></tr><tr><td>7.</td><td>Complete Agitator assembly</td><td>1 no. of each type and size</td></tr></table> 1.07.00 <u>Slurry Pumps</u> (Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone slurry supply Pumps and any other slurry pumps) <table><tr><td>1.</td><td>Impeller Assembly</td><td>4 no. of each type and size</td></tr><tr><td>2.</td><td>Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing)</td><td>1 no. of each type and size</td></tr><tr><td>3.</td><td>Casing Liners (where replaceable liners are provided)</td><td>1 set*</td></tr><tr><td>4.</td><td>Seals</td><td>4 set of each type and size</td></tr><tr><td>5.</td><td>Bearings</td><td>1 no. of each type and size</td></tr><tr><td>6.</td><td>Motor</td><td>1 no. of each type and size</td></tr><tr><td>7.</td><td>GEAR BOX</td><td>1 No. for each type and size of pump.</td></tr><tr><td>8.</td><td>Motor-Pump Coupling</td><td>1 no. of each type</td></tr></table> 1.08.00 <u>Hydro-Cyclones</u> (Mill , Gypsum Primary Dewatering,			1.	Impeller Assembly	1 no. of each type	2.	Bearing Assembly	1 no. of each type	3.	Motor	1 no. of each type	4.	Belt and Pulley (If applicable)	1 no. of each type	5.	Gear Box Assembly (If Applicable)	1 no. of each type	6.	Agitator shaft assembly	1 no. of each type and size	7.	Complete Agitator assembly	1 no. of each type and size	1.	Impeller Assembly	4 no. of each type and size	2.	Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing)	1 no. of each type and size	3.	Casing Liners (where replaceable liners are provided)	1 set*	4.	Seals	4 set of each type and size	5.	Bearings	1 no. of each type and size	6.	Motor	1 no. of each type and size	7.	GEAR BOX	1 No. for each type and size of pump.	8.	Motor-Pump Coupling	1 no. of each type
1.	Impeller Assembly	1 no. of each type																																														
2.	Bearing Assembly	1 no. of each type																																														
3.	Motor	1 no. of each type																																														
4.	Belt and Pulley (If applicable)	1 no. of each type																																														
5.	Gear Box Assembly (If Applicable)	1 no. of each type																																														
6.	Agitator shaft assembly	1 no. of each type and size																																														
7.	Complete Agitator assembly	1 no. of each type and size																																														
1.	Impeller Assembly	4 no. of each type and size																																														
2.	Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing)	1 no. of each type and size																																														
3.	Casing Liners (where replaceable liners are provided)	1 set*																																														
4.	Seals	4 set of each type and size																																														
5.	Bearings	1 no. of each type and size																																														
6.	Motor	1 no. of each type and size																																														
7.	GEAR BOX	1 No. for each type and size of pump.																																														
8.	Motor-Pump Coupling	1 no. of each type																																														
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-VII MANDATORY SPARES																																													
PAGE 7 OF 82																																																

CLAUSE NO.	MANDATORY SPARES							
	Secondary Waste Water and any other Hydrocyclone) 1. Hydro-cyclone Isolation Valve 10% of each type OR 1 no. whichever is higher 2. Hydro-Cyclone 10% of each type OR 1 no. whichever is higher 3. Hydro-Cyclone rubber lining-Feed chamber and Overflow chamber 10% of each type OR 1 no. whichever is higher 4. Vortex finder & Apex inserts 10% of each type OR 1 no. whichever is higher 1.09.00 <u>Feeders</u> 1. Belt 2 sets * 2. Belt drive motor 1 nos. 3. Belt drive reducer 1 nos. 4. Speed Reducer Assembly 1 set* 5. Weighing Instruments 1 set* 6. Feeder weighing roll 1 no. 7. Gravimetric feeder gate actuator assembly 1 no. 8. Counter assembly of feeder complete 1 no. 9. Feeder head pulley assembly 1 no. 1.10.00 <u>Limestone Mills</u> 1. Mill Wear Parts (Liners) & Grinding element 1 sets Note : One set of Mill Wear Parts (Liners) above is defined as under : 1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 x 1) / GWL, rounded off to nearest <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-VII MANDATORY SPARES</td><td>PAGE 8 OF 82</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-VII MANDATORY SPARES	PAGE 8 OF 82
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-VII MANDATORY SPARES	PAGE 8 OF 82				

CLAUSE NO.	MANDATORY SPARES																																																																	
	higher whole number. Where : GWL =Guaranteed wear life of Mill Wear Parts as offered by the bidder. <table><tr><td>2.</td><td>Mill Motor</td><td>1 no.</td></tr><tr><td>3.</td><td>Auxiliary Motor</td><td>1 no.</td></tr><tr><td>4.</td><td>Gear box internals (including Bearings and Seals)</td><td>2 sets *</td></tr><tr><td>5.</td><td>Complete Gear Box</td><td>1 sets *</td></tr><tr><td>6.</td><td>Mill motor Bearings</td><td>1 sets *</td></tr><tr><td>7.</td><td>Lube Oil / Grease System</td><td></td></tr><tr><td>7.1</td><td>Pump assembly</td><td>1 nos. of each type</td></tr><tr><td>7.2</td><td>Motor</td><td>1 nos. of each type</td></tr><tr><td>7.3</td><td>Pressure regulator</td><td>1 nos. of each type</td></tr><tr><td>7.4</td><td>Filters</td><td>2 nos. of each type</td></tr><tr><td>7.5</td><td>Pump & Motor coupling</td><td>1 nos. of each type</td></tr><tr><td>1.11.00</td><td><u>Slurry Valves</u></td><td>4 no. of each type and size</td></tr><tr><td>1.12.00</td><td><u>Slurry Line Bends</u></td><td>4 no. of each type and size</td></tr><tr><td>1.13.00</td><td><u>Vacuum Belt Filter</u></td><td></td></tr><tr><td>1.</td><td>Filter Cloth</td><td>4 sets</td></tr><tr><td>2.</td><td>Belt</td><td>1 sets</td></tr><tr><td>3.</td><td>Vacuum Box Seals</td><td>2 sets</td></tr><tr><td>4.</td><td>Drive Motor</td><td>1 no.</td></tr><tr><td>1.14.00</td><td><u>Vacuum Pumps</u></td><td></td></tr><tr><td>1.</td><td>Pump Impeller Assembly</td><td>1 no.</td></tr><tr><td>2.</td><td>Pump Bearing</td><td>1 set</td></tr></table>			2.	Mill Motor	1 no.	3.	Auxiliary Motor	1 no.	4.	Gear box internals (including Bearings and Seals)	2 sets *	5.	Complete Gear Box	1 sets *	6.	Mill motor Bearings	1 sets *	7.	Lube Oil / Grease System		7.1	Pump assembly	1 nos. of each type	7.2	Motor	1 nos. of each type	7.3	Pressure regulator	1 nos. of each type	7.4	Filters	2 nos. of each type	7.5	Pump & Motor coupling	1 nos. of each type	1.11.00	<u>Slurry Valves</u>	4 no. of each type and size	1.12.00	<u>Slurry Line Bends</u>	4 no. of each type and size	1.13.00	<u>Vacuum Belt Filter</u>		1.	Filter Cloth	4 sets	2.	Belt	1 sets	3.	Vacuum Box Seals	2 sets	4.	Drive Motor	1 no.	1.14.00	<u>Vacuum Pumps</u>		1.	Pump Impeller Assembly	1 no.	2.	Pump Bearing	1 set
2.	Mill Motor	1 no.																																																																
3.	Auxiliary Motor	1 no.																																																																
4.	Gear box internals (including Bearings and Seals)	2 sets *																																																																
5.	Complete Gear Box	1 sets *																																																																
6.	Mill motor Bearings	1 sets *																																																																
7.	Lube Oil / Grease System																																																																	
7.1	Pump assembly	1 nos. of each type																																																																
7.2	Motor	1 nos. of each type																																																																
7.3	Pressure regulator	1 nos. of each type																																																																
7.4	Filters	2 nos. of each type																																																																
7.5	Pump & Motor coupling	1 nos. of each type																																																																
1.11.00	<u>Slurry Valves</u>	4 no. of each type and size																																																																
1.12.00	<u>Slurry Line Bends</u>	4 no. of each type and size																																																																
1.13.00	<u>Vacuum Belt Filter</u>																																																																	
1.	Filter Cloth	4 sets																																																																
2.	Belt	1 sets																																																																
3.	Vacuum Box Seals	2 sets																																																																
4.	Drive Motor	1 no.																																																																
1.14.00	<u>Vacuum Pumps</u>																																																																	
1.	Pump Impeller Assembly	1 no.																																																																
2.	Pump Bearing	1 set																																																																
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-VII MANDATORY SPARES PAGE 9 OF 82																																																															

CLAUSE NO.	MANDATORY SPARES 		
	2. Guide roller of each type 3. Contactors of each type 4 Control Transformer 5. Time device 6. Rectifiers 7. Overcurrent relay 8. Auxiliary relay 9. Resistor 10. Fuses of each rating 11. Limit switches of each type 12. Push button 13. Contact device (if applicable) 14. Brake motor 15. Transmitters 16. Switches of each type 17. Receiver 18. Bearings of each type & size 19. Roller of each type 20. Worm gear spares 'O' rings Sealing ring of each type 21. Spares for brake 20% of total population or 3 nos. of type whichever is higher 2 nos. 1 no. of each type 2 nos. of each type 4 nos. of each type 2 nos. of each type 3 nos. of each type 3 nos. of each type 20% of the total population 3 nos. 3 nos. of each type 3 nos. of each type 2 nos. of each type 2 nos. of each type 3 nos. 2 nos. of each type 2 nos. 3 nos. 3 sets * 3 sets *		
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-VII MANDATORY SPARES		PAGE 11 OF 82	

CLAUSE NO.	MANDATORY SPARES		
	Fan	2 nos. of each type	
	Magnetic coil	3 nos. of each type	
	Brake disc	2 sets *	
	Brake pad	2 sets *	
	22. Bushing (for door front)	2 sets *	
	23. Pinion	2 nos. of each type	
	24. Elevator Motor with VVVF drive	1 no of each type	

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC	
1.19.00	<u>EQUIPMENT COOLING WATER SYSTEM</u> (except VALLUR TPP & SIMHADRI STPP)			
	A-1) Spares for horizontal pumps for ECW system (for each type & size)			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with nuts & other accessories	Set	1
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
	3)	Shaft	Set	1
	4)	Shaft Sleeves	Set	2
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
	6)	Pump bearings	Set	1
	7)	Mechanical Seal (if applicable)	Set	1
Note : One(1) set consists of quantity required for complete replacement for one(1) Pump of each type/size				
A- 2) Spares for Electrically operated hoist for FGD system for ECW system (for each type & size)				
Sl. No.	Name of Items	Unit	QTY.	
1)	Bearings	Set	1	
2)	Rope guide	Set	1	
3)	Brake lining	Set	1	
4)	Wire rope	Set	1	
Note : One(1) set consists of quantity required for complete replacement for one(1) hoist of each type & capacity				
A- 3) Spares for Plate type heat exchangers for ECW system (for each type & size)				
Sl. No.	Name of Items	Unit	QTY.	
1)	Gaskets	Lot	comprising 30% of total requirement	
2)	Fasteners	Lot	comprising 10% each type	
3)	Plates	Lot	comprising 20% of each type	
Note : One(1) set consists of quantity required for complete replacement for one(1) heat exchanger of each type & capacity				
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-VII MANDATORY SPARES
PAGE 13 OF 82				

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
1.20.00	PRE-TREATMENT PLANT CUM ECW SYSTEM FOR SIMHADRI STPP-II (2x500 MW)			
	Sl. No.	Name of Items	Unit	Qty
	1) <u>CLARIFIERS : PT System</u>			
	1)	Turbine drive motor	Set	1
	2)	Rake (Scraper) drive motor	Set	1
	3)	Turbine drive shaft assembly	Set	1
	4)	Rake (Scraper) drive shaft assembly	Set	1
	5)	Oil seal for gear box	Set	4
	6)	Worm wheel	Set	1
	7)	Worm shaft	Set	1
	8)	All Bearings required for motors, Turbine drive, and Rack drive	Set	1
	Note: One set consists of quantity required for complete replacement for one clarifier or motor as the case may be			
	2) <u>Lime Slurry Transfer Pumps, Lime Dosing Pumps</u>			
	1)	Lime Dosing Pump Unit	No	1
	2)	Lime Slurry Transfer Pump Unit	No	1
	3)	Coupling between Pump & motor, bushes, pins with all fasteners & coupling Guards (for each type of pump)	Set	1
	4)	Gland , Packing & Gland Assembly	Set	1
Note : One set consists of quantity required for complete replacement for one pump				
3) <u>Alum Dosing Pumps : PT System</u>				
1)	Alum Dosing Pump Unit (for each system)	No	1	
Note : One set consists of quantity required for complete replacement for one pump				
4) <u>Vertical Sump Pumps – Sludge disposal pumps</u>				
<u>Vertical Wet Pit pump-Raw water pump</u>				
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-VII MANDATORY SPARES	PAGE 14 OF 82

CLAUSE NO.	MANDATORY SPARES			
	Sl. No.	Name of Items	Unit	QUANTITY
	1)	Complete Casing including suction (if applicable) bell	Set	1
	2)	Impeller	Set	1
	3)	Wearing rings – Impeller (if applicable)	Set	2
	4)	Wearing rings – Casing (if applicable)	Set	2
	5)	Impeller Shaft, line shaft and head shaft	Set	1
	6)	Shaft Sleeves	Set	2
	7)	Stuffing box	Set	1
	8)	Coupling between Pump & motor, bushes, pins with all fasteners & coupling Guards.	Set	1
	9)	Line Shaft Couplings (if applicable)	Set	1
	10)	Impeller, Line and Head shaft bearings (as applicable)	Set	1
	11)	Gland , Packing & Gland Assembly	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	5) Agitators			
	Sl. No.	Name of Items	Unit	QTY
1)	Agitator Assembly with Gear Box – Lime Slaking Tank	Set	1	
2)	Agitator Assembly with Gear Box – Lime Preparation Tank – PT System	Set	1	
3)	Agitator Assembly with Gear Box – Alum Preparation Tank	Set	1	
6) Valves				
Sl. No.	Name of Items	Unit	QTY	

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-VII MANDATORY SPARES	PAGE 15 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	Sl. No.	Name of Items	Unit	Qty
	1)	Manual Plug Valve	Set	5% or min 1 no of each type & size
	2)	Motor operated Plug Valve (without motor actuator)	Set	-do-
	3)	Check Valves /Non-return Valve	Set	-do-
	4)	Manual Ball Valve	Set	-do-
	5)	Motor operated Ball Valve (without motor actuator)	Set	-do-
	6)	Manual Globe Valve	Set	-do-
	7)	Manual Diaphragm Valve	Set	-do-
	8)	Motor operated Diaphragm Valve (without motor actuator)	Set	-do-
	9)	Diaphragm for the above Diaphragm Valves	Set	-do-
	10)	Manual Butterfly Valve	Set	-do-
	11)	Motor operated Butterfly Valve (without motor actuator)	Set	-do-
	12)	Manual Gate Valve	Set	-do-
	13)	Motor operated Gate Valve (without motor actuator)	Set	-do-
	Note: One set consists of quantity required for complete replacement for one valve of each type/ size/Rating.			
	7) Air Blowers for Sludge pit			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with shaft	Set	1
	2)	All Bearings (Blower & Motor)	Set	1
	3)	Oil seals	Set	1
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-VII MANDATORY SPARES	PAGE 16 OF 82

CLAUSE NO.	MANDATORY SPARES			
	Sl. No.	Name of Items	Unit	Qty
	4)	Gears	Set	1
	5)	Filters	Nos	2
	Note : One set consists of quantity required for complete replacement for one valve of each type/ size/Rating.			
	8) Vertical (wet pit) Pumps- Raw water pumps			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with nuts & washers	Set	1 set of each type
	2)	Bearings for Line, Head and Impeller shafts	Set	-do-
	3)	Thrust Bearings of pump & drive	Set	-do-
	4)	Wearing rings – Impeller (if applicable)	Set	-do-
	5)	Wearing rings – Casing (if applicable)	Set	-do-
	6)	Gland, packing & gland assembly	Set	-do-
	7)	Impeller Shaft, line shaft and head shaft	Set	-do-
	8)	Shaft Sleeves	Set	-do-
	9)	Stuffing box	Set	-do-
10)	Pump & Drive Coupling, bushes, pins with all fasteners & coupling guards (as applicable)	Set	-do-	
11)	All Gaskets	Set	-do-	
12)	Motor Bearings	Set	-do-	
13)	Line Shaft Couplings (if applicable)	Set	-do-	
Note : One set consists of quantity required for complete replacement for one pump				
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-VII MANDATORY SPARES	PAGE 17 OF 82

CLAUSE NO.	MANDATORY SPARES																																																																		
1.21.00	<u>DESALINATION – PRE-TREATMENT PLANT CUM ECW SYSTEM FOR VALLUR TPP-II (3x500 MW)</u> MECHANICAL EQUIPMENTS A) – SWRO SYSTEM A-1) RO (Reverses Osmosis-2nd Stage) Plant – Membranes <table border="0"> <thead> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr> </thead> <tbody> <tr> <td>1)</td><td>RO Membranes</td><td>LOT</td><td>10% of total installed membranes in all the three streams / trains</td></tr> </tbody> </table> A- 2) High Pressure Pumps (2nd Stage RO Plant) <table border="0"> <thead> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr> </thead> <tbody> <tr> <td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr> <tr> <td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>2</td></tr> <tr> <td>3)</td><td>Shaft</td><td>Set</td><td>1</td></tr> <tr> <td>4)</td><td>Shaft Sleeves</td><td>Set</td><td>2</td></tr> <tr> <td>5)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr> <tr> <td>6)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr> <tr> <td>7)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr> </tbody> </table> Note : One set consists of quantity required for complete replacement for one Pump A-3) Cartridge Filtration Units (2nd Stage RO Plant) <table border="0"> <thead> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr> </thead> <tbody> <tr> <td>1)</td><td>Cartridge Filters Elements</td><td>LOT</td><td>30% of total installed in all the three streams/trains</td></tr> </tbody> </table> A-4) RO Plant Feed Pumps (2nd Stage RO Plant) and Permeate transfer pumps <table border="0"> <thead> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY for Each pump</th></tr> </thead> <tbody> <tr> <td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr> <tr> <td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>2</td></tr> <tr> <td>3)</td><td>Shaft</td><td>Set</td><td>1</td></tr> </tbody> </table>	Sl. No.	Name of Items	Unit	QTY	1)	RO Membranes	LOT	10% of total installed membranes in all the three streams / trains	Sl. No.	Name of Items	Unit	QTY	1)	Impeller with nuts & other accessories	Set	1	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	3)	Shaft	Set	1	4)	Shaft Sleeves	Set	2	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	6)	Pump bearings	Set	1	7)	Mechanical Seal	Set	1	Sl. No.	Name of Items	Unit	QTY	1)	Cartridge Filters Elements	LOT	30% of total installed in all the three streams/trains	Sl. No.	Name of Items	Unit	QTY for Each pump	1)	Impeller with nuts & other accessories	Set	1	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	3)	Shaft	Set	1		
Sl. No.	Name of Items	Unit	QTY																																																																
1)	RO Membranes	LOT	10% of total installed membranes in all the three streams / trains																																																																
Sl. No.	Name of Items	Unit	QTY																																																																
1)	Impeller with nuts & other accessories	Set	1																																																																
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2																																																																
3)	Shaft	Set	1																																																																
4)	Shaft Sleeves	Set	2																																																																
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																
6)	Pump bearings	Set	1																																																																
7)	Mechanical Seal	Set	1																																																																
Sl. No.	Name of Items	Unit	QTY																																																																
1)	Cartridge Filters Elements	LOT	30% of total installed in all the three streams/trains																																																																
Sl. No.	Name of Items	Unit	QTY for Each pump																																																																
1)	Impeller with nuts & other accessories	Set	1																																																																
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2																																																																
3)	Shaft	Set	1																																																																
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-VII MANDATORY SPARES PAGE 18 OF 82																																																																

CLAUSE NO.	MANDATORY SPARES																																																																			
	4) Shaft Sleeves Set 2 5) Pump & Drive Coupling, bushes, pins with all fasteners Set 1 6) Pump bearings Set 1 7) Gland , Packing & Gland Assembly or Mechanical Seal as applicable Set 1 Note : One set consists of quantity required for complete replacement for one Pump A-5) Chemical Cleaning System (2nd Stage RO Plant)<table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Mixer (Agitator) of Chemical Tanks</td><td>No</td><td>1</td></tr><tr><td>2)</td><td>Chemical Cleaning Pump</td><td>No</td><td>1</td></tr><tr><td>3)</td><td>Cartridge Filter Element</td><td>Set</td><td>1</td></tr></table> A-6) Flushing Cleaning System (2nd Stage RO Plant)<table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Flushing Pump</td><td>No</td><td>1</td></tr></table> A-7) SWRO Plant – Membranes<table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>SWRO Membranes</td><td>LOT</td><td>10% of total installed membranes in all the three streams / trains</td></tr></table> A- 8) High Pressure Feed Pumps (SWRO Plant)<table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>2</td></tr><tr><td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>4</td></tr><tr><td>3)</td><td>Shaft</td><td>Set</td><td>2</td></tr><tr><td>4)</td><td>Shaft Sleeves</td><td>Set</td><td>4</td></tr><tr><td>5)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr><tr><td>6)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr><tr><td>7)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr></table> Note : One set consists of quantity required for complete replacement for one Pump				Sl. No.	Name of Items	Unit	QTY	1)	Mixer (Agitator) of Chemical Tanks	No	1	2)	Chemical Cleaning Pump	No	1	3)	Cartridge Filter Element	Set	1	Sl. No.	Name of Items	Unit	QTY	1)	Flushing Pump	No	1	Sl. No.	Name of Items	Unit	QTY	1)	SWRO Membranes	LOT	10% of total installed membranes in all the three streams / trains	Sl. No.	Name of Items	Unit	QTY	1)	Impeller with nuts & other accessories	Set	2	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	4	3)	Shaft	Set	2	4)	Shaft Sleeves	Set	4	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	6)	Pump bearings	Set	1	7)	Mechanical Seal	Set	1
Sl. No.	Name of Items	Unit	QTY																																																																	
1)	Mixer (Agitator) of Chemical Tanks	No	1																																																																	
2)	Chemical Cleaning Pump	No	1																																																																	
3)	Cartridge Filter Element	Set	1																																																																	
Sl. No.	Name of Items	Unit	QTY																																																																	
1)	Flushing Pump	No	1																																																																	
Sl. No.	Name of Items	Unit	QTY																																																																	
1)	SWRO Membranes	LOT	10% of total installed membranes in all the three streams / trains																																																																	
Sl. No.	Name of Items	Unit	QTY																																																																	
1)	Impeller with nuts & other accessories	Set	2																																																																	
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	4																																																																	
3)	Shaft	Set	2																																																																	
4)	Shaft Sleeves	Set	4																																																																	
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																	
6)	Pump bearings	Set	1																																																																	
7)	Mechanical Seal	Set	1																																																																	
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-VII MANDATORY SPARES	PAGE 19 OF 82																																																																

CLAUSE NO.	MANDATORY SPARES																																																																														
	A- 9) Energy Recovery (ERU) Units <table> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr> <tr> <td>1)</td><td>For SWRO Plant offered with Turbo Charger Option</td><td></td><td></td></tr> <tr> <td>a)</td><td>Complete Rotating Assembly</td><td>Set</td><td>1</td></tr> <tr> <td>b)</td><td>Upstream & Downstream isolation valves</td><td>Set</td><td>1</td></tr> <tr> <td>c)</td><td>Coupling between HP Pump & turbo charger, , bushes, pins with all fasteners (if applicable)</td><td>Set</td><td>1</td></tr> <tr> <td>2)</td><td>For SWRO Plant offered with Pressure Exchanger (PX) Option</td><td></td><td></td></tr> <tr> <td>a)</td><td>PX Exchangers</td><td>LOT</td><td>100 % of PX units installed for one SWRO train/stream</td></tr> <tr> <td>b)</td><td>Upstream & Downstream isolation valves</td><td>LOT</td><td>10% of Valves installed for one SWRO train/stream</td></tr> <tr> <td>c)</td><td>PX Booster Pumps</td><td></td><td></td></tr> <tr> <td>i)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>2</td></tr> <tr> <td>ii)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>4</td></tr> <tr> <td>iii)</td><td>Shaft</td><td>Set</td><td>2</td></tr> <tr> <td>iv)</td><td>Shaft Sleeves</td><td>Set</td><td>4</td></tr> <tr> <td>v)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr> <tr> <td>vi)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr> <tr> <td>vii)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr> </table> Note : One set consists of quantity required for complete replacement for one Turbo Charger / PX pump as the case may be A- 10) Chemical Cleaning System (SWRO Plant) <table> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr> <tr> <td>1)</td><td>Mixer (Agitator) of Chemical Tanks</td><td>No</td><td>1</td></tr> <tr> <td>2)</td><td>Chemical Cleaning Pump & Motor</td><td>No</td><td>1</td></tr> </table>	Sl. No.	Name of Items	Unit	QTY	1)	For SWRO Plant offered with Turbo Charger Option			a)	Complete Rotating Assembly	Set	1	b)	Upstream & Downstream isolation valves	Set	1	c)	Coupling between HP Pump & turbo charger, , bushes, pins with all fasteners (if applicable)	Set	1	2)	For SWRO Plant offered with Pressure Exchanger (PX) Option			a)	PX Exchangers	LOT	100 % of PX units installed for one SWRO train/stream	b)	Upstream & Downstream isolation valves	LOT	10% of Valves installed for one SWRO train/stream	c)	PX Booster Pumps			i)	Impeller with nuts & other accessories	Set	2	ii)	Wearing rings (Impeller & Casing ; as applicable)	Set	4	iii)	Shaft	Set	2	iv)	Shaft Sleeves	Set	4	v)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	vi)	Pump bearings	Set	1	vii)	Mechanical Seal	Set	1	Sl. No.	Name of Items	Unit	QTY	1)	Mixer (Agitator) of Chemical Tanks	No	1	2)	Chemical Cleaning Pump & Motor	No	1		
Sl. No.	Name of Items	Unit	QTY																																																																												
1)	For SWRO Plant offered with Turbo Charger Option																																																																														
a)	Complete Rotating Assembly	Set	1																																																																												
b)	Upstream & Downstream isolation valves	Set	1																																																																												
c)	Coupling between HP Pump & turbo charger, , bushes, pins with all fasteners (if applicable)	Set	1																																																																												
2)	For SWRO Plant offered with Pressure Exchanger (PX) Option																																																																														
a)	PX Exchangers	LOT	100 % of PX units installed for one SWRO train/stream																																																																												
b)	Upstream & Downstream isolation valves	LOT	10% of Valves installed for one SWRO train/stream																																																																												
c)	PX Booster Pumps																																																																														
i)	Impeller with nuts & other accessories	Set	2																																																																												
ii)	Wearing rings (Impeller & Casing ; as applicable)	Set	4																																																																												
iii)	Shaft	Set	2																																																																												
iv)	Shaft Sleeves	Set	4																																																																												
v)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																												
vi)	Pump bearings	Set	1																																																																												
vii)	Mechanical Seal	Set	1																																																																												
Sl. No.	Name of Items	Unit	QTY																																																																												
1)	Mixer (Agitator) of Chemical Tanks	No	1																																																																												
2)	Chemical Cleaning Pump & Motor	No	1																																																																												
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-VII MANDATORY SPARES	PAGE 20 OF 82																																																																												

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC																																																																								
	3) Cartridge Filter ElementsSet1 A- 11) Flushing Cleaning System (SWRO Plant) <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Flushing Pump & motor</td><td>No</td><td>1</td></tr></table> A- 12) Waste Disposal (Brine) Pumps <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr><tr><td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>2</td></tr><tr><td>3)</td><td>Shaft</td><td>Set</td><td>1</td></tr><tr><td>4)</td><td>Shaft Sleeves</td><td>Set</td><td>2</td></tr><tr><td>5)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr><tr><td>6)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr><tr><td>7)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr></table> Note : One set consists of quantity required for complete replacement for one Pump B) – PRE-TREATMENT SYSTEM B-1) Cartridge Filtration Units (For SWRO Plant) <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Cartridge Filters Elements</td><td>LOT</td><td>30% of total installed membranes in all the three streams/trains</td></tr></table> B-2) Dual Media (DMF) Filters <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1</td><td>Inlet Water Distributor Assembly</td><td>Set</td><td>2</td></tr><tr><td>2</td><td>Strainers / Nozzles of Under drain Collector OR Header Lateral Collector (which ever is applicable)</td><td>Set</td><td>1</td></tr><tr><td>3</td><td>Filter Media</td><td>LOT</td><td>One full charge for one filter + 10%</td></tr></table> Note : One set consists of quantity required for complete replacement for one filter B-3) Filter Backwash Water Pumps <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr></table>				Sl. No.	Name of Items	Unit	QTY	1)	Flushing Pump & motor	No	1	Sl. No.	Name of Items	Unit	QTY	1)	Impeller with nuts & other accessories	Set	1	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	3)	Shaft	Set	1	4)	Shaft Sleeves	Set	2	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	6)	Pump bearings	Set	1	7)	Mechanical Seal	Set	1	Sl. No.	Name of Items	Unit	QTY	1)	Cartridge Filters Elements	LOT	30% of total installed membranes in all the three streams/trains	Sl. No.	Name of Items	Unit	QTY	1	Inlet Water Distributor Assembly	Set	2	2	Strainers / Nozzles of Under drain Collector OR Header Lateral Collector (which ever is applicable)	Set	1	3	Filter Media	LOT	One full charge for one filter + 10%	Sl. No.	Name of Items	Unit	QTY	1)	Impeller with nuts & other accessories	Set	1
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Flushing Pump & motor	No	1																																																																									
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Impeller with nuts & other accessories	Set	1																																																																									
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2																																																																									
3)	Shaft	Set	1																																																																									
4)	Shaft Sleeves	Set	2																																																																									
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																									
6)	Pump bearings	Set	1																																																																									
7)	Mechanical Seal	Set	1																																																																									
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Cartridge Filters Elements	LOT	30% of total installed membranes in all the three streams/trains																																																																									
Sl. No.	Name of Items	Unit	QTY																																																																									
1	Inlet Water Distributor Assembly	Set	2																																																																									
2	Strainers / Nozzles of Under drain Collector OR Header Lateral Collector (which ever is applicable)	Set	1																																																																									
3	Filter Media	LOT	One full charge for one filter + 10%																																																																									
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Impeller with nuts & other accessories	Set	1																																																																									
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-VII MANDATORY SPARES	PAGE 21 OF 82																																																																								

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	B-3) Filter Backwash Water Pumps			
	Sl. No.	Name of Items	Unit	QTY
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
	3)	Shaft	Set	1
	4)	Shaft Sleeves	Set	2
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
	6)	Pump bearings	Set	1
	7)	Mechanical Seal	Set	1
	Note : One set consists of quantity required for complete replacement for one Pump of each type / rating/ size			
	B-4) Filter Air Blowers (Air scouring of DMF)			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with nuts & other accessories	Set	1
	2)	Shaft	Set	1
	3)	Bearings of Blowers	Set	1
	4)	Suction filter Assembly	Set	1
	5)	V Belts (if applicable)	Set	1
	Note : One set consists of quantity required for complete replacement for one blower of each type / rating/ size			
	B-5) Filter Feed Pumps			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with nuts & other accessories	Set	1
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
	3)	Shaft	Set	1
	4)	Shaft Sleeves	Set	2
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
	6)	Pump bearings	Set	1
7)	Mechanical Seal	Set	1	
Note : One set consists of quantity required for complete replacement for one Pump				
B-6) <u>LAMELA CLARIFIER / TUBE SETTLER</u>				
Sl. No.	Name of Items	Unit	Qty	
1)	Mixer of Flocculation Chamber			
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-VII MANDATORY SPARES	PAGE 22 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	B-6) <u>LAMELA CLARIFIER / TUBE SETTLER</u>			
	Sl. No.	Name of Items	Unit	Qty
		a) Bearings	Set	1
		b) Oil seals of Gear box	Set	2
		c) Gear Box Assembly	Set	1
	2)	Flash Mixer		
		a) Bearings	Set	1
		b) Oil seals of Gear box	Set	2
		c) Gear Box Assembly	Set	1
	3)	Internals of Clarifiers with nuts, fasteners and other accessories (Tube Packs/ Plates etc)	LOT	20% of total installed internals in both the clarifiers
	Note : One set consists of quantity required for complete replacement for one complete mixer			
	B- 7) Sludge Disposal Pumps			
	Sl. No.	Name of Items	Unit	QTY
	1)	Impeller with nuts & other accessories	Set	1
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
	3)	Shaft	Set	1
	4)	Shaft Sleeves	Set	2
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6)	Pump bearings	Set	1	
7)	Mechanical Seal	Set	1	
Note : One set consists of quantity required for complete replacement for one Pump				
C) – CHEMICAL STORAGE & DOSING SYSTEM				
C-1) <u>Coagulant Unloading cum Transfer Pumps</u>				
Sl. No.	Name of Items	Unit	QTY.	
1)	Impeller with nuts & other accessories	Set	1	
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	
3)	Shaft	Set	1	
4)	Shaft Sleeves	Set	2	
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	
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-VII MANDATORY SPARES	PAGE 23 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	C-1)_Coagualnt Unloading cum Transfer Pumps			
	Sl. No.	Name of Items	Unit	QTY.
	6)	Pump bearings	Set	1
	7)	Mechanical Seal	Set	1
	8)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	C- 2) Coagualnt Dosing Pumps			
	Sl. No.	Name of Items	Unit	QUANTITY
	1)	Diaphragm	Set	3
	2)	Oil seals of gear box	Set	1
	3)	Connecting Rod with nuts & blots	Set	1
	4)	Worm & worm wheel	Set	1
	5)	All pump Bearings including Cross head guide Bearings	Set	2
	6)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	C- 3) Coagulant Aid Dosing Pumps			
	Sl. No.	Name of Items	Unit	QUANTITY
	1)	Diaphragm	Set	3
	2)	Oil seals of gear box	Set	1
	3)	Connecting Rod with nuts & blots	Set	1
	4)	Worm & worm wheel	Set	1
	5)	All pump Bearings including Cross head guide Bearings	Set	2
	6)	Complete Pump and motor	Set	1
Note : One set consists of quantity required for complete replacement for one pump				
C- 4) Anti-Scalant Dosing Pumps				
Sl. No.	Name of Items	Unit	QUANTITY	
1)	Diaphragm	Set	3	
2)	Oil seals of gear box	Set	1	
3)	Connecting Rod with nuts & blots	Set	1	
4)	Worm & worm wheel	Set	1	

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-VII MANDATORY SPARES	PAGE 24 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	C- 4) Anti-Scalant Dosing Pumps			
	Sl. No.	Name of Items	Unit	QUANTITY
	5)	All pump Bearings including Cross head guide Bearings	Set	2
	6)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	C- 5) Anti-Oxidant Dosing Pumps			
	Sl. No.	Name of Items	Unit	QUANTITY
	1)	Diaphragm	Set	3
	2)	Oil seals of gear box	Set	1
	3)	Connecting Rod with nuts & blots	Set	1
	4)	Worm & worm wheel	Set	1
	5)	All pump Bearings including Cross head guide Bearings	Set	2
	6)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	C-6) Acid Unloading cum Transfer Pumps			
	Sl. No.	Name of Items	Unit	QTY.
	1)	Impeller with nuts & other accessories	Set	1
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
	3)	Shaft	Set	1
	4)	Shaft Sleeves	Set	2
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
	6)	Pump bearings	Set	1
	7)	Mechanical Seal	Set	1
	8)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
C- 7) Acid Dosing Pumps (SWRO)				
Sl. No.	Name of Items	Unit	QUANTITY	
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-VII MANDATORY SPARES	PAGE 25 OF 82

CLAUSE NO.	MANDATORY SPARES	एनटीपीसी NTPC																																																																																																	
	C- 7) Acid Dosing Pumps (SWRO) <table> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QUANTITY</th></tr> <tr> <td>1)</td><td>Diaphragm</td><td>Set</td><td>3</td></tr> <tr> <td>2)</td><td>Oil seals of gear box</td><td>Set</td><td>1</td></tr> <tr> <td>3)</td><td>Connecting Rod with nuts & blots</td><td>Set</td><td>1</td></tr> <tr> <td>4)</td><td>Worm & worm wheel</td><td>Set</td><td>1</td></tr> <tr> <td>5)</td><td>All pump Bearings including Cross head guide Bearings</td><td>Set</td><td>2</td></tr> <tr> <td>6)</td><td>Complete Pump and motor</td><td>Set</td><td>1</td></tr> </table> Note: One set consists of quantity required for complete replacement for one Pump of each type / rating/ size. C- 8) Alkali Unloading Pumps <table> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY.</th></tr> <tr> <td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr> <tr> <td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>2</td></tr> <tr> <td>3)</td><td>Shaft</td><td>Set</td><td>1</td></tr> <tr> <td>4)</td><td>Shaft Sleeves</td><td>Set</td><td>2</td></tr> <tr> <td>5)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr> <tr> <td>6)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr> <tr> <td>7)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr> <tr> <td>8)</td><td>Complete Pump and motor</td><td>Set</td><td>1</td></tr> </table> Note : One set consists of quantity required for complete replacement for one pump C- 9) Alkali Transfer cum re-circulation Pumps <table> <tr> <th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY.</th></tr> <tr> <td>1)</td><td>Impeller with nuts & other accessories</td><td>Set</td><td>1</td></tr> <tr> <td>2)</td><td>Wearing rings (Impeller & Casing ; as applicable)</td><td>Set</td><td>2</td></tr> <tr> <td>3)</td><td>Shaft</td><td>Set</td><td>1</td></tr> <tr> <td>4)</td><td>Shaft Sleeves</td><td>Set</td><td>2</td></tr> <tr> <td>5)</td><td>Pump & Drive Coupling, bushes, pins with all fasteners</td><td>Set</td><td>1</td></tr> <tr> <td>6)</td><td>Pump bearings</td><td>Set</td><td>1</td></tr> <tr> <td>7)</td><td>Mechanical Seal</td><td>Set</td><td>1</td></tr> </table>	Sl. No.	Name of Items	Unit	QUANTITY	1)	Diaphragm	Set	3	2)	Oil seals of gear box	Set	1	3)	Connecting Rod with nuts & blots	Set	1	4)	Worm & worm wheel	Set	1	5)	All pump Bearings including Cross head guide Bearings	Set	2	6)	Complete Pump and motor	Set	1	Sl. No.	Name of Items	Unit	QTY.	1)	Impeller with nuts & other accessories	Set	1	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	3)	Shaft	Set	1	4)	Shaft Sleeves	Set	2	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	6)	Pump bearings	Set	1	7)	Mechanical Seal	Set	1	8)	Complete Pump and motor	Set	1	Sl. No.	Name of Items	Unit	QTY.	1)	Impeller with nuts & other accessories	Set	1	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	3)	Shaft	Set	1	4)	Shaft Sleeves	Set	2	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	6)	Pump bearings	Set	1	7)	Mechanical Seal	Set	1		
Sl. No.	Name of Items	Unit	QUANTITY																																																																																																
1)	Diaphragm	Set	3																																																																																																
2)	Oil seals of gear box	Set	1																																																																																																
3)	Connecting Rod with nuts & blots	Set	1																																																																																																
4)	Worm & worm wheel	Set	1																																																																																																
5)	All pump Bearings including Cross head guide Bearings	Set	2																																																																																																
6)	Complete Pump and motor	Set	1																																																																																																
Sl. No.	Name of Items	Unit	QTY.																																																																																																
1)	Impeller with nuts & other accessories	Set	1																																																																																																
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2																																																																																																
3)	Shaft	Set	1																																																																																																
4)	Shaft Sleeves	Set	2																																																																																																
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																																																
6)	Pump bearings	Set	1																																																																																																
7)	Mechanical Seal	Set	1																																																																																																
8)	Complete Pump and motor	Set	1																																																																																																
Sl. No.	Name of Items	Unit	QTY.																																																																																																
1)	Impeller with nuts & other accessories	Set	1																																																																																																
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2																																																																																																
3)	Shaft	Set	1																																																																																																
4)	Shaft Sleeves	Set	2																																																																																																
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1																																																																																																
6)	Pump bearings	Set	1																																																																																																
7)	Mechanical Seal	Set	1																																																																																																
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-VII MANDATORY SPARES	PAGE 26 OF 82																																																																																																

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	C- 9) Alkali Transfer cum re-circulation Pumps			
	Sl. No.	Name of Items	Unit	QTY.
	8)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one pump			
	C- 10) Alkali Dosing Pumps (SWRO)			
	Sl. No.	Name of Items	Unit	QUANTITY
	1)	Diaphragm	Set	3
	2)	Oil seals of gear box	Set	1
	3)	Connecting Rod with nuts & blots	Set	1
	4)	Worm & worm wheel	Set	1
	5)	All pump Bearings including Cross head guide Bearings	Set	2
	6)	Complete Pump and motor	Set	1
	Note : One set consists of quantity required for complete replacement for one Pump of each type / rating/ size.			
	C-11) Agitator			
	Name of Items		Unit	QTY
Agitator Assembly with Motor & Gear Box of		Set	1	
a) Coagulant Preparation Tank		Set	1	
b) Coagulant aid Preparation Tank		Set	1	
c) Anti-Scalant Preparation Tank		Set	1	
d) Anti-Oxidant Preparation Tank		Set	1	
e) Alkali preparation Tank		Set	1	
f) Alkali Measuring Tanks (of MB Unit)		Set	1	
g) Alkali Measuring Tanks (of RO Plant)		Set	1	
C-12) Activated Carbon Filter				
Sl. No.	Name of Items	Unit	QUANTITY	
1)	Strainers for activated carbon filters or Header lateral	No / Set	10% or 1 Set as the case may be.	
2)	Activated Carbon filter media	%	110% of One AC filter	
Note: One set consists of quantity required for complete replacement for one AC filter of each type /application as the case may be.				
D) –MISCELLANEOUS EQUIPMENTS (Applicable for all the Systems)				

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-VII MANDATORY SPARES	PAGE 27 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC																																																																								
	D- 1) Valves (except Control Valves) – For Sizes 80 mm NB and less <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Valves of all types</td><td>LOT</td><td>2 numbers of each type / size /material of construction</td></tr></table> D- 2) Valves (except Control Valves) – For Sizes above 80 mm NB <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Sluice Valves / Gate Valves</td><td></td><td></td></tr><tr><td></td><td>a) Seats, Rings, Gaskets, Gland, Packing & Nuts</td><td>LOT</td><td>1 set of each type / size /material of construction</td></tr><tr><td></td><td>b) Complete Valve (including gear operator as applicable)</td><td>LOT</td><td>1 number of each type / size /material of construction</td></tr><tr><td>2)</td><td>Butterfly Valves</td><td></td><td></td></tr><tr><td></td><td>a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings</td><td>LOT</td><td>1 set of each type / size /material of construction</td></tr><tr><td></td><td>b) Complete Valve (including gear operator as applicable)</td><td>LOT</td><td>1 number of each type / size /material of construction</td></tr><tr><td>3)</td><td>Diaphragm Valves</td><td></td><td></td></tr><tr><td></td><td>a) Diaphragms</td><td>No</td><td>2 each type / size /material of construction</td></tr><tr><td></td><td>b) Seats, Rings, Gaskets, Gland, Packing & Nuts & Bush</td><td>LOT</td><td>1 set of each type / size /material of construction</td></tr><tr><td></td><td>c) Complete Valve (including gear operator as applicable)</td><td>LOT</td><td>1 number of each type / size /material of construction</td></tr><tr><td>4)</td><td>Globe Valves</td><td></td><td></td></tr><tr><td></td><td>a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings</td><td>LOT</td><td>1 set of each type / size /material of construction</td></tr><tr><td></td><td>b) Complete Valve (including gear operator as applicable)</td><td>LOT</td><td>1 number of each type / size /material of construction</td></tr><tr><td>5)</td><td>Plug Valves</td><td></td><td></td></tr><tr><td></td><td>a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Plug</td><td>LOT</td><td>1 set of each type / size /material of construction</td></tr></table>				Sl. No.	Name of Items	Unit	QTY	1)	Valves of all types	LOT	2 numbers of each type / size /material of construction	Sl. No.	Name of Items	Unit	QTY	1)	Sluice Valves / Gate Valves				a) Seats, Rings, Gaskets, Gland, Packing & Nuts	LOT	1 set of each type / size /material of construction		b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction	2)	Butterfly Valves				a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction		b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction	3)	Diaphragm Valves				a) Diaphragms	No	2 each type / size /material of construction		b) Seats, Rings, Gaskets, Gland, Packing & Nuts & Bush	LOT	1 set of each type / size /material of construction		c) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction	4)	Globe Valves				a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction		b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction	5)	Plug Valves				a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Plug	LOT	1 set of each type / size /material of construction
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Valves of all types	LOT	2 numbers of each type / size /material of construction																																																																									
Sl. No.	Name of Items	Unit	QTY																																																																									
1)	Sluice Valves / Gate Valves																																																																											
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts	LOT	1 set of each type / size /material of construction																																																																									
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction																																																																									
2)	Butterfly Valves																																																																											
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction																																																																									
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction																																																																									
3)	Diaphragm Valves																																																																											
	a) Diaphragms	No	2 each type / size /material of construction																																																																									
	b) Seats, Rings, Gaskets, Gland, Packing & Nuts & Bush	LOT	1 set of each type / size /material of construction																																																																									
	c) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction																																																																									
4)	Globe Valves																																																																											
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Disc, & Bearings	LOT	1 set of each type / size /material of construction																																																																									
	b) Complete Valve (including gear operator as applicable)	LOT	1 number of each type / size /material of construction																																																																									
5)	Plug Valves																																																																											
	a) Seats, Rings, Gaskets, Gland, Packing & Nuts, Plug	LOT	1 set of each type / size /material of construction																																																																									
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-VII MANDATORY SPARES PAGE 28 OF 82																																																																								

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC																																																					
	b) Complete Valve (including gear operator as applicable) LOT1 number of each type / size /material of construction 6) Check Valves of all types a) Seats, Rings, Disc/ Door/ Flap, Hinge& Door pins, Gland, Packing & Nuts, Gaskets, Ball (for lift type) LOT1 set of each type / size /material of construction b) Complete Valve LOT1 number of each type / size /material of construction 7) Air Release Valves a) Seats, Rings, Gaskets LOT1 set of each type / size /material of construction b) Complete Valve LOT1 number of each type / size /material of construction Note : One set consists of quantity required for complete replacement for one pump D-3) E.O.T Crane <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY</th></tr><tr><td>1)</td><td>Bearings for wheels</td><td>Set</td><td>1</td></tr><tr><td>2)</td><td>Brake liners for all the Brakes</td><td>Set</td><td>1</td></tr><tr><td>3)</td><td>Hydraulic thrusters for Brakes</td><td>Set</td><td>1</td></tr><tr><td>4)</td><td>Wire rope for Crane</td><td>Length</td><td>1</td></tr><tr><td>5)</td><td>Electrical Items of Crane</td><td></td><td></td></tr><tr><td>a)</td><td>Carbon brushes and brush holders for motors</td><td>Set</td><td>1</td></tr><tr><td>b)</td><td>Solenoid coils for all brakes</td><td>Set</td><td>1</td></tr><tr><td>c)</td><td>Overload relays for motors</td><td>Set</td><td>1</td></tr><tr><td>d)</td><td>Set of fuses</td><td>Set</td><td>1</td></tr><tr><td>e)</td><td>Limit switches for main hoist, long travel & Cross travel</td><td>Set</td><td>1</td></tr></table> Note : One set consists of quantity required for complete replacement for one crane of each type & capacity D-4) ELECTRICALLY OPERATED HOISTS <table><tr><th>Sl. No.</th><th>Name of Items</th><th>Unit</th><th>QTY.</th></tr><tr><td>1)</td><td>Bearings</td><td>Set</td><td>1</td></tr></table>				Sl. No.	Name of Items	Unit	QTY	1)	Bearings for wheels	Set	1	2)	Brake liners for all the Brakes	Set	1	3)	Hydraulic thrusters for Brakes	Set	1	4)	Wire rope for Crane	Length	1	5)	Electrical Items of Crane			a)	Carbon brushes and brush holders for motors	Set	1	b)	Solenoid coils for all brakes	Set	1	c)	Overload relays for motors	Set	1	d)	Set of fuses	Set	1	e)	Limit switches for main hoist, long travel & Cross travel	Set	1	Sl. No.	Name of Items	Unit	QTY.	1)	Bearings	Set	1
Sl. No.	Name of Items	Unit	QTY																																																					
1)	Bearings for wheels	Set	1																																																					
2)	Brake liners for all the Brakes	Set	1																																																					
3)	Hydraulic thrusters for Brakes	Set	1																																																					
4)	Wire rope for Crane	Length	1																																																					
5)	Electrical Items of Crane																																																							
a)	Carbon brushes and brush holders for motors	Set	1																																																					
b)	Solenoid coils for all brakes	Set	1																																																					
c)	Overload relays for motors	Set	1																																																					
d)	Set of fuses	Set	1																																																					
e)	Limit switches for main hoist, long travel & Cross travel	Set	1																																																					
Sl. No.	Name of Items	Unit	QTY.																																																					
1)	Bearings	Set	1																																																					
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-VII MANDATORY SPARES	PAGE 29 OF 82																																																				

CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
	D-4) ELECTRICALLY OPERATED HOISTS				
	Sl. No.	Name of Items	Unit	QTY.	
	2)	Rope guide	Set	1	
	3)	Brake lining	Set	1	
	4)	Wire rope	Set	1	
	Note : One set consists of quantity required for complete replacement for one hoist of each type & capacity				
	D-5 Spares for Plate type heat exchangers for ECW system (for each type & size)				
	Sl. No.	Name of Items	Unit	QTY.	
	1)	Gaskets	Lot	Comprising 30% of total requirement	
	2)	Fasteners	Lot	Comprising 10% of each type	
	3)	Plates	Lot	Comprising 20% of each type	
	Note : One set consists of quantity required for complete replacement for one plate type heat exchanger of each type and capacity				
	D-6) Spares for horizontal pumps for ECW system (for each type & size)				
	Sl. No.	Name of Items	Unit	QTY.	
	1)	Impeller with nuts & other accessories	Set	1	
	2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2	
	3)	Shaft	Set	1	
	4)	Shaft Sleeves	Set	2	
	5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1	
	6)	Pump bearings	Set	1	
	7)	Mechanical Seal (if applicable)	Set	1	
	Note : One(1) set consists of quantity required for complete replacement for one(1) Pump of each type/size				
D- 7) – Ventilation System					
S.N.	Name of Items	Unit	Qty		
1	Pre filters & Fine filters	Set	1 number of each type/size/model		
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-VII MANDATORY SPARES	PAGE 30 OF 82	

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
1.22.00	D- 8) AIR CONDITIONING SYSTEM			
	Sl. No.	Name of Items	Unit	QTY.
	1)	Compressor with motor	Set	1 number of each type/size/model
	2)	Evaporator and condenser fan	Set	1 number of each type/size/model
	3)	Fan belt (Evaporator and condenser)	Set	1 number of each type/size/model
	4)	Fan bearing (Evaporator and condenser)	Set	1 number of each type/size/model
	5)	Fan motor bearing (Evaporator and condenser)	Set	1 number of each type/size/model
	6)	Filters	Set	1 number of each type/size/model
	<u>AIR CONDITINING AND VENTILATION SYSTEM</u>			
	1.0	Air handling unit (for each model)		
	1.1	V-belts for AHU Blower	2 Sets	
	1.2	AHU Blower bearing	1 Set	
	1.3	Blower motor bearing	1 Set	
	1.4	Filters at suction and discharge of all AHUs	25% of installed population	
	2.0	Unitary air filtration unit		
	2.1	Supply Air fans		
	2.1.1	V-belts for supply air fans	2 Sets	
	2.1.2	Supply air fan bearings	1 Set	
	2.2	UAF Pump		
	2.2.1	Pump bearings	1 Set	
	2.2.2	Impeller for pump	1 no.	
	2.2.3	Pump Shaft	1 no.	
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-VII MANDATORY SPARES	PAGE 31 OF 82

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	2.2.4 Shaft sleeves 1 Set 2.2.5 Gland Packings for pumps 1 Set 2.2.6 Nylon Filter 1 Set 2.2.7 Spray nozzles 5% of total population or 50 Numbers whichever is higher. 2.2.8 Water strainer 1 No. 2.2.9 Brass suction screen/strainer for unitary air filtration tank. 1 Set 2.2.10 Motor for Centrifugal fan for UAF 1 No 3.0 Control & Instrumentation i) Air-Conditioning System 3.1 Electronic Transmitters 3.1.1 Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.) 5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population) 3.2 Temperature elements 3.2.1 RTD's* 5% or 1 No. which ever is more ** 3.2.2 Thermo well 5% or 1 No. which ever is more ** * (With head assembly, terminal block and nipple) ** (to be divided into various insertion lengths in proportion to main population) 3.3 All types of Local Indicators 5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in		
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-VII MANDATORY SPARES	PAGE 32 OF 82

CLAUSE NO.	MANDATORY SPARES		
		proportion to main population of all make, model and type) 3.4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, and temperature, and differential temperature, level switch Devices. 3.5 Relative Humidity Sensors 3.6 Geysersstat 3.7 Local Humidity/Temperature indicators 4.0 Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable) 4.1 Valves 4.2 2 way, 3way, 5way valve manifolds 4.3 Fittings (II) Ventilation System 5.0 Measuring Instruments 5.1 Pressure Gauge 5.2 Level transmitter 5.3 Pressure transmitter 6.0 Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable) 5% or 1No. of each type and model whichever is more. 1 No. 1 No. 2 Nos. each 10% or 1 No. of each type, class, size and model whichever is more. 10% or 1 No. of each type, class, size and model whichever is more. 10% or 1 No. of each type, class, size and model whichever is more. 1 No. (for centrifugal pumps of UAF units). 1 No. 1 No. (for UAF units)	
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-VII MANDATORY SPARES
PAGE 33 OF 82			

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
1.23.00	6.1 Valves		1 no. of each type, class, size and model	
	6.2 2 way valve manifold		1 no. of each type, class, size and model	
	6.3 Fittings		1 no. of each type, class, size and model	
	<u>FIRE DETECTION AND PROTECTION SYSTEM</u>			
	ITEM DESCRIPTION		QUANTITY	
	1.0 DELUGE VALVE ASSEMBLIES			
	1.1 Complete deluge valve assembly along with internals and accessories			
	1.1.1 150 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.1.2 100 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.1.3 80 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.2 Clapper assembly complete (consisting of clapper seat rubber, screws, etc.)			
	1.2.1 150 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.2.2 100 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.2.3 80 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.3 Solenoid coils			
	1.3.1 150 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.3.2 100 NB		10% or 1 No. of each type, class, size and model whichever is more.	
	1.3.3 80 NB		10% or 1 No. of each type, class, size and model whichever is more.	
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-VII MANDATORY SPARES PAGE 34 OF 82

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	ITEM DESCRIPTION	QUANTITY	
2.0	VALVES (BUTTERFLY)		
2.1	Butterfly		
2.1.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.1.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.1.2	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.2	Disc (Butterfly)		
2.2.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.2.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.2.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.3	Stem for Butterfly Valve		
2.3.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.3.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.3.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4	Gasket for Butterfly Valve		
2.4.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4.2	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.5	Bushing/Bearing (butterfly valve)		

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-VII MANDATORY SPARES	PAGE 35 OF 82

CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
2.5.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.5.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.5.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
3.0	BASKET STRAINERS / Y-TYPE STRAINERS for HVW / MVW SPRAY SYSTEM		
3.1	Strainer elements with o-rings and stiffeners.		
3.1.1	Y- Type strainer		
3.1.1.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
3.1.1.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
3.1.1.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
4.0	MVW SPRAY SYSTEM		
4.1	Spray Nozzles	10% or 10 No. of each type, class, size and model whichever is more.	
4.2	QB Detectors	10% or 20 No. of each type, class, size and model whichever is more.	
5.0	HVW SPRAY SYSTEM		
5.1	Spray nozzles	10% or 10 No. of each type, class, size and model whichever is more.	
5.2	QB Detectors	10% or 20 No. of each type, class, size and model whichever is more.	
6.0	FIRE DETECTORS		
6.1	Multisensor detectors (Addressable)	10% or 10 No. of each type, class, size and model whichever is more.	
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-VII MANDATORY SPARES
PAGE 36 OF 82			

CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
	6.2 Indicators assembly for smoke detectors provided in false ceiling (Response indicator)	10% or 10 No. of each type, class, size and model whichever is more.	
	6.3 LHS cable for conveyors	10% of each type, class, size and model whichever is more.	
	7.0 CONTROL AND INSTRUMENTATION		
	7.1 MEASURING INSTRUMENTS		
	7.1.1 All types of Local indicators	1 no. of each make, model and type	
	7.1.2 Process Actuated Switch Devices : (All types of Pressure, diff. pressure, flow, temperature, level switch devices).	1 no. of each type and model	
	7.1.3 All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	10% or 1 no. of each type and model whichever is more.	
	7.1.4 Limit switches for isolation valves	1 no. of each type	
	7.2 PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)		
	7.2.1 Valves	1 no. of each type, class, size and model.	
	7.2.2 2 way, 3 way, 5 way valve manifolds	1 no. of each type, class, size and model.	
	7.2.3 Fittings	5% or 1 no. of each type, class, size and model whichever is more.	
	7.3 CABLES		
	7.3.1 Pre fabricated cable of each type.	1 no. of each type, size and model.	
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-VII MANDATORY SPARES PAGE 37 OF 82

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC	
	ITEM DESCRIPTION	QUANTITY		
7.3.2	Pre fabricated cable connector	1 no. of each type and model		
7.3.3	Other cables (including fire proof cable, fibre optic cables etc)	5% of each type, pair/ core and size of actual installed quantity.		
7.4	FIRE ALARM PANEL & REPEATER FIRE ALARM PANEL			
7.4.1	Fuses	100% of population		
7.4.2	Indicating lamps	100% of population		
7.4.3	Push Button	10 Nos. of each type and rating		
7.4.4	Power supply modules	10% or 1 No. of each type & rating whichever is more		
7.4.5	Control modules, loop cards modules, isolator cards	10% or 1 No. of each type, whichever is more.		
7.4.6	LCD display of each type unit of panel	1 No.		
7.4.7	Cartridges for printers	2 Nos.		
7.4.8	Interface unit / modules for non-addressable devices, auxiliary / output relay modules, control modules, supervisory control modules and any other electronic modules	10% or 1 No. of each type whichever is more.		
7.4.9	LED's of each type	100% of population.		
7.4.10	Power supervision relay	4 Nos. of each type.		
7.4.11	Fire screen / alarm buzzer	1 No. of each type		
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-VII MANDATORY SPARES	PAGE 38 OF 82

CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION PLC CONTROL SYSTEM 7.5	QUANTITY Quantity 7.5.1 Power Supply Unit Electronic modules(I/O modules, communication modules and any other module used in the system) 7.5.2 Central Processor Unit 7.5.3 Interconnecting Cables 7.5.4 Cooling Fan in PLC system / cabinet 7.5.5 Indication lamps of all types 7.5.6 Graphical Interface Unit 7.5.7 24V – DC POWER SUPPLY SYSTEM 7.6 CTs, CVTs, VTs, chokes, AC/DC isolators, contactors, timers, relays 7.6.1 Fuses of each type and rating 7.6.2 Fuse free Circuit breakers 7.6.3 Electronic modules of all types 7.6.4 Indication lamps 7.6.5 Cooling Fans 7.6.6	1 No. of each type and model, 10% or 1 No. of each type and model, whichever is more. 1 No. of each type and model 10% of each type & size 2 Nos. 100% 1 No. 5% or 2 Nos. of each type and rating whichever is more. 200% 5% or 5 Nos. of each type and rating whichever is more. One No. of each type 100% 1 No. of each type
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-VII MANDATORY SPARES
PAGE 39 OF 82			

CLAUSE NO.	MANDATORY SPARES			
1.24.00	7.6.7	Indicators	1 No of each type and rating	
	7.6.8	Relays of all types including overload relays	2 Nos. of each type and rating	
	7.6.9	Batteries	5% or 2 nos. of each type & rating whichever is more	
	<u>COMPRESSED AIR SYSTEM:</u> (except Project NSPCL Rourkela (1x 250 MW))			
		ITEM DESCRIPTION	QUANTITY	
	1.0	Oil free Screw Air Compressor		
	1.1	H. P. Stage Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating	
	1.2	L. P. Stage Complete LP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end),Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.	1 Set of each type/rating	
	1.3	Motor Bearings	2 Sets	
	1.4	LP stage Gear and Pinion	1 Set	
	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-VII MANDATORY SPARES
	PAGE 40 OF 82			

CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
1.5	HP stage Gear and Pinion	1 Set	
1.6	Air Intake Filter Element With Gaskets	4 Sets	
1.7	Oil Filter Element With Gaskets & Seals	4 Sets	
1.8	Safety Valve Springs and Gaskets for HP stage	1 Set	
1.9	Safety Valve Springs and Gaskets for LP stage	1 Set	
1.10	Valves (within the compressor house actuators	with 2 nos of each type/ratings/ size.	
1.11	Oil Pump/Motor		
1.11.1	Oil Pump and Motor complete assembly	1 Set	
1.11.2	Pump impeller/rotor with shaft	1 Set	
1.11.3	Set of bearings	2 Set	
1.11.4	Set of Seals	2 Set	
1.12	Drain / Moisture Trap	2 Set of each type/size.	
1.13	Oil Cooler Gaskets & Seals	2 sets	
2.0	AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM (As applicable)		
2.1	Pre filter element(Ceramic candle or as applicable)	2 sets	
2.2	After filter element(Ceramic candle or as applicable)	2 sets	
2.3	Heater element(if applicable)	1 sets	
2.4	Blower bearing(if applicable)	1 sets	
2.5	Blower motor bearing(if applicable)	2 sets	
2.6	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets	
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-VII MANDATORY SPARES
PAGE 41 OF 82			

CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
	2.7Heater coil for temperature stabilization (for HOC type)(as applicable)	2 sets	
	3.3Rotary drum type Air drying plant for Instrument Air system (As applicable)		
	3.3.1Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set	
	3.4Motor for air compressor	1 no.	
	MEASURING INSTRUMENTS		
	1Electronic Transmitters		
	(i) Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or 1 No. of each type and model, whichever is more	
	2Temperature elements		
	(i) RTD's* of each type and length	10% or 2 Nos. of each type and length Which ever is more	
	ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. of each type and length Which ever is more	
	(iii) Thermowell for application like mill outlet temperature and SH/RH/Eco/ true gas temp. in furnace	10% or 2 Nos. of each type and length Which ever is more	
	(iv) Temperature transmitters	10% of each type and length whichever is more	
	3Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make,	
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-VII MANDATORY SPARES	PAGE 42 OF 82

CLAUSE NO.	MANDATORY SPARES		
1.25.00	ITEM DESCRIPTION 4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices 5 Dew Point meters		QUANTITY 5% or 1 No. of each type and model whichever is more 5% or 1 No. of each type and model whichever is more
	3.6 MICROPROCESSOR BASED/PLC BASED CONTROL/ ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE) 1 Fully programmed controller of electronic modules of each type (as applicable) 2 Power supply module (if applicable)		10% or 1 no. whichever is more 10% or 1 no. whichever is more
	NOTE: 1. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment. 2. Any fraction of a item shall mean the next higher integer. 3. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number. 4. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid. 5. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.		
	LIMESTONE & GYPSUM HANDLING S.N. If Applicable (Y/N) ITEM QUANTITY Unit 1 Mechanical A) Paddle Feeder		

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-VII MANDATORY SPARES	PAGE 43 OF 82

CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	1		Rotor arm with Liners & Bolts	1	sets of each type
	2		Liners of rotor arms	2	sets of each type
	3		Gear box (including Paddle wheel, Travel drive, cable reel drive)	1	set of each type
	i)		Complete assembly	1	set of each type
	ii		Bearings	2	nos. of each size
	iii)		Oil Seals	2	sets of each type
	iv)		Input shaft with pinion		
	4		Hydraulic Power Pack		
	i)		Rotor Pump with electric motor, coupling, valves & servo motor (mounted on pump)etc.	2	set of each type and rating
	ii)		Solenoid Valves complete with coils	2	set of each type and size
	iii)		Filter element (1 No. Pressure Filter + 1 No. Return Filter)	10	sets of each type
	iv)		Hydraulic Hoses	4	sets
	v)		Hydraulic Motor (for Paddle wheel)	2	nos of each type
	vi)		Hydraulic Motor (for Traverse Drive)	2	nos of each type
	vii)		Traverse pump with electric motor, coupling, valves (mounted on pump) & servo motor (mounted on pump)etc.	2	sets of each type
	viii)		Dust suppression pump and motor assembly	1	nos of each type
	ix)		Spray nozzles of dust suppression system	10	nos of each type
	x)		Cooler	1	nos of each type
	5		Carriage wheel assembly		
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-VII MANDATORY SPARES	PAGE 44 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY Unit	
			i) Bearings	2 nos. of each type & size	
			ii) Plummer Block	2 nos. of each type & size	
			iii) Oil seals	2 nos. of each type & size	
			iv) Carriage wheel with shaft (without plummer blocks)	1 sets	
			v) Traverse drive assy including electric motor, gear box, coupling etc. Or Geared Motor as applicable	1 set	
			vi) Tension roller of paddle feeder trolley	1 set	
	6	i)	All type of coupling (including those between electric motor and pump, between hydraulic motor and gear box and between gear box and paddle wheel & between carriage wheel and motor)	2 nos. of each type	
		ii)	Coupling bolt with bushes / spider / inserts	2 sets of each size	
		iii)	Rubber bush / spider / inserts	8 sets of each size	
	7	i)	Brakes (if any)	2 sets of each type & size	
		ii)	Brake shoe	4 sets of each type & size	
	8		Cable reel drive		
		i)	Complete drive unit assembly including motor, gear box, coupling etc.	1 sets of each type & rating	
		ii)	Chain	2 nos.	
		iii)	Plummer Block and bearings for cable reel drum	1 sets	
		iv)	Cable guide assembly	1 set	
		vii)	Torque regulator unit	1 set	
		viii)	Friction pads	2 set	
		ix)	Spring stacks	2 set	
		x)	Oil seals	4 sets	
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-VII MANDATORY SPARES	PAGE 45 OF 82

CLAUSE NO.	MANDATORY SPARES					
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit	
			xi)	Eddy current/magnetic coupling	1	set of each type & rating nos.
			xii)	Spare Festoon hanger cum roller assembly(below CRD)	10	
			xiii)	Spare energy chain links	5%	of population
	B)		IDLERS			
	1	i)	35° Troughing idlers complete with base frame and mounting brackets etc.	2.5%	of population of each type	
		ii)	Rolls for (i) above	1%	of population of each type	
	2	i)	Troughing idlers complete with base frame & mounting brackets etc.(for belt feeder).	30%	of population of each type	
		ii)	Rolls for (i) above	30%	of population of each type	
	3	i)	35° impact idlers complete with mounting brackets and base frame etc.	25%	of population of each type	
		ii)	Rolls for (i) above	25%	of population of each type	
	4		35° troughing training idler complete with base frame and brackets etc. (if used)	10%	of population of each type	
	5		Transition idler complete as in (1) above	10%	of population of each type	
	6		Flat return idlers complete with mounting brackets etc.	2%	of population of each type	
	7		Flat return idlers complete with mounting brackets etc.(for belt feeders)	30%	of population of each type	
	8		Flat return trainer complete with mounting brackets etc.	10%	of population of each type	
	9		Belt cleaning spiral rubber disc return idler complete with mounting brackets etc.	20%	of population of each type	
	10	i)	Two roll 10° troughing return idler assy	2%	of population of each type	
		ii)	Rolls for (I) above	2%	of population of each type	
	11		SS idlers	25%	of population of each type	
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-VII MANDATORY SPARES		PAGE 46 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	12		Any other type of idlers	10%	of population of each type
	C)		CONVEYOR GEAR BOXES		
	i)		Input shafts with pinion	1	set of each type and rating
	ii)		Oil seals	2	sets of each type and rating
	iii)		Bearings	1	set of each type and rating
	iv)		Hold back device	2	nos. of each type and rating
	v)		Cooling fan with cover	2	nos.of each type and rating
	vi)		Complete gear box assy with hold back device	1	set of each type and rating for population upto 10 nos.
				2	set of each type and rating for population more than 10 nos.
	D)		CONVEYOR DRIVE AND CONVEYOR BELT		
	a)		Gear Coupling		
	i)		All type of drive couplings including gear Coupling	2	nos. of each type
	ii)		Bolts for gear coupling	2	sets of each size
	iii)		Seal kit for gear coupling (o-ring)	2	sets of each type
	b)		Fluid Coupling		
	i)		Fluid Coupling complete	1	no. of each type and size
	ii)		Multi Disc assembly (for fluid coupling)	4	nos each type and size
	iii)		Resilient Drive plate assy.	1	no. of each type and size
	iv)		Bearings	1	no. of each type and size
	v)		Seal kit for fluid coupling	2	sets of each size
	vi)		Fusible plug	10	nos. of each size
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-VII MANDATORY SPARES	PAGE 47 OF 82	

CLAUSE NO.	MANDATORY SPARES 			
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY Unit
	vii)		Complete actuator and engaging assembly (including motor, gear box etc.)	1 set of each type
	viii)		Oil Cooler assembly (if applicable)	1 set of each type
	ix)		Oil pump-motor set (if applicable)	1 set of each type
	x)		Oil filters	5 sets of each type
	xi)		Oil/Cooler valves (if applicable)	2 nos. of each type
	c)		Belting	
			Conveyor Belt	
	i)		Main Conveyors	2 drum length of 250 m of each type, size and rating if total population of particular type, size and rating of conveyor is equal to or more than 2500 m
				1 drum length of 250 m of each type, size and rating if total population of particular type, size and rating of conveyor is less than 2500 m
	ii)		Belt feeder & bunker seal belt, as applicable	one complete length of each type
	d)		Brakes	
	i)		Brakes	1 no of each size & type
	ii)		Brake shoes	2 sets of each size
	E)		PULLEYS	
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-VII MANDATORY SPARES PAGE 48 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	i)		Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging)	1	no. of each type and size in pulley drum and shaft dia.(for population upto 10 Nos)
				2	no. of each type and size in pulley drum and shaft dia.(for population more than 10 Nos)
	ii)		Plummer Block complete with bearings & sleeves	2	no. each type and size
	iii)		SS Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging)	1	no. of each type and size in pulley drum and shaft dia.
	F)				
			BELT CLEANERS AND SKIRT BOARD		
	i)		Modular segments for belt cleaner	5	%of total population of each type & size
	ii)		Modular segments skirt rubber for skirt board	5	%of total population of each type & size
	iii)		Skirt Rubber	5	%of total population of each type & size
	iv)		Complete belt cleaner (internal / external)	2	%of total population of each type & size
	G)				
			IN-LINE MAGNETIC SEPARATORS		
	i)		Cleated conveyor belt	1	set
	ii)		Motor, gear box drive assy. complete	1	set
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-VII MANDATORY SPARES	PAGE 49 OF 82	

CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	iii)		Pulleys with plummer block & bearings	1	set of each size & type
	iv)		Sheaves	1	no. of each size & type
	v)		V-belts	2	no. of each size & type
	H)		LIME SAMPLER		
	i)		Plummer block	1	no. of each type and size
	ii)		Hammers	1	set of each type and size
	iii)		Liner plate	1	set
	iv)		Cutter lip	1	no.
	v)		Cutter seal	1	no.
	vi)		V-belts (for crusher)	1	sets
	vii)		Hammer pins	1	sets of each type and size
	viii)		Pulley	1	no. of each type and size
	ix)		Conveyor belt	1.2	times length of each type and rating
	x)		Gear box assembly for conveyor	1	no. of each type and rating
	xi)		Gear box drive assy, for primary and secondary samplers	1	set of each type and rating
	xii)		Hydraulic pump with motor and coupling	1	set of each type
	xiii)		Hydraulic motor	1	set of each type
	xiv)		Hydraulic cylinder	1	set of each type
	xv)		Cylinder sealing kit	2	set of each type
	xvi)		Set of hoses	2	set of each type
	xvii)		Coupling with grid for primary sampler	2	sets
	xviii)		Screw conveyor gear box assembly	1	set
	I)		LIME CRUSHER		
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-VII MANDATORY SPARES	PAGE 50 OF 82

CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	i)		Plummer Block assembly complete including bearing, lock nut, lock washer etc.(DE+NDE)	2	set
	ii)		Shaft seal	4	sets
	iii)		Hammer sets	10	sets or 750 Nos whichever is more (1 set means hammers required for one crusher)
	iv)		Rotor assembly complete consisting of rotor shaft & keys, End discs, Centre discs, distance rings, suspension bars, disc clamping nuts and shaft extension etc. but without hammers, bearings and pillow blocks	1	set
	v)		Cage bars/Perforated screen plates as applicable	4	sets
	vi)		Breaker plate	4	sets
	vii)		Liners	2	sets
	viii)		Suspension bars	4	set
	ix)		Kick-off plate	4	set
	x)		Screen plate upper & lower	4	no. each
	xi)		Tramp iron pick up plate	2	no. each
	xii)		Fluid coupling		
	a)		Fluid coupling complete	1	set
	b)		Bearings	2	set
	c)		Seal kit (sealing rings)	2	sets
	d)		Fusible plugs	8	nos.
	e)		Oil pump motor set (if applicable)	1	set of each type
	f)		Oil filter	3	sets
	g)		Complete actuator and engaging assembly (including motor, gear box etc.)	1	set
	h)		Cooler assembly (if applicable)	1	no.
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-VII MANDATORY SPARES	PAGE 51 OF 82

CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	i)		Oil / Water valves	2	nos. of each type
	j)		Gear Coupling/ other flexible coupling of crusher drive along with bolts and sealing kit, as applicable	2	sets
	l)		Multi Disc assembly (for fluid coupling)	2	sets. of each type and rating
	m)		Resilient Drive plate assy	2	sets. of each type and rating
	J)		VIBRATING (GRIZZLY/SCREENING) FEEDER		
	i)		Bearings	2	no. of each type & size
	ii)		Seals	2	no. of each size
	iii)		Liners	1	sets.
	iv)		Screen plates	10	sets
	v)		Complete vibrating assembly consisting of all rotating parts including drive & driven unbalanced shafts including bearings, casing, spring, vibrating blocks, main shaft, sheave & unbalanced weights as applicable.	1	set of each type and rating and direction
	vi)		Hoses (if applicable)	2	set
	vii)		Drive unit assembly (including electric motor, hydraulic pump, hydraulic motor, , flexible shaft, gear box, as applicable)	1	set
	viii)		Base springs, rubber pads	2	sets. of each type & size
	ix)		V belts	4	sets. of each type & size
	K)		ELECTRIC HOISTS		
	i)		Brake linings	2	sets of each type
	ii)		Rope guide & rope tightner	1	no. of each type
	iii)		Limit switch	2	nos. of each type & size
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-VII MANDATORY SPARES	PAGE 52 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	iv)		Gear box/gear set	2	sets of each type
	v)		Motor/geared motor	1	no of each type & rating
	vi)		Drum bearing	1	set of each type & rating
	L)		FLAP GATES (INCLUDING THAT OF TRIPPERS)		
	i)		Limit switch	8	nos. of each type & rating
	ii)		Actuator (complete with motor, gear box,limit switches etc.)	1	nos. of each type & rating
	iii)		Oil seals of Actuator	2	nos. of each type & rating
	iv)		Flap gate shaft	1	nos. of each type & rating
	v)		Pressure nut	12	nos. of each type & size
	M)		RACK & PINION GATE		
	i)		Limit switch	2	no. of each type & size
	ii)		Rollers with bearings	2	no. of each size
	iii)		Motor gear box assembly	1	set of each type
	iv)		Actuator (complete with motor, gear box, limit switches etc.)	1	nos of each type & rating
	N)		SUMP PUMP		
	i)		Complete pump assembly with pump, motor, coupling base etc	1	set
	ii)		Impeller with key & nut	2	set of each size & type
	iii)		Oil seal	2	nos. of each size
	iv)		Coupling bolt with bushes	2	set of each type
	v)		Pump shaft	2	no. of each size
	vi)		Shaft sleeve	2	sets of each size
	vii)		Bearing bush	2	sets of each size
	viii)		Set of bearings	2	sets
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-VII MANDATORY SPARES	
PAGE 53 OF 82					

CLAUSE NO.	MANDATORY SPARES 			
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY Unit
	O)		DUST SUPPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER	
	a)		Pump impeller with key & nut	1 set of each type & size
	b)		Pump Shaft	1 no of each type & size
	c)		Bearings	1 sets each type & size
	d)		Wearing rings	2 sets of each type & size
	e)		Shaft sleeve	2 sets of each type & size
	f)		Bushings	2 sets of each type & size
	g)		Coupling bolts & nuts (with bushes) 2 sets	1 sets each type & size
	h)		Spray nozzles	50 nos.of each type & size
	i)		Spray nozzles (for plain water dust suppression)	25 nos.of each type & size
	j)		Solenoid valves	5 % of each type and size
	k)		Globe valve / plug valves	10 % of each type and size
	l)		Gate valve	2 nos. of each size
	m)		Strainers	1 no. of each type
	n)		Compressor	
	(i)		Air filter element	8 Nos.
	(ii)		Oil filter	6 Nos.
	(iii)		Discharge Check Valve	3 Nos.
	(iv)		Oil Pump Parts (including distance ring, eccentric rings, Pump element, Pin, Key O, Ring) as applicable	2 Sets
	(v)		Inlet Valve Assembly	2 Nos.
	(vi)		Electronic regulator	3 Nos.
	P)		VENTILATION SYSTEM	
	i)		V-Belt	1 set of each type
	ii)		Pre-filter element of pressurizing fans	2 sets of each type
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-VII MANDATORY SPARES PAGE 54 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	iii)		Foundation Rubber pads	1	sets of each type & size
	iv)		Bearings	1	sets of each type & size
	v)		Plummer Blocks	1	set of each type & size
	Q)		TRAVELLING TRIPPER		
	i)		Complete drive assembly including gear box, coupling, brake etc.	1	set
	ii)		Complete internals of speed reducer (including input shaft, output shaft, gearset)	1	set of each size & type
	iii)		Bearings for reducer	2	sets
	iv)		Drive axle with wheels, plummer blocks, bearings etc.	1	set
	v)		Oil seals	2	nos. of each size
	vi)		Non-drive axle with wheels plummer blocks, bearings etc.	1	set of each type
	vii)		Flap gate actuator with motor, gear box, position / thrust switches	1	set of each type
	viii)		Chain assembly with sprockets	1	set of each type & size
	ix)		Festoon Roller assembly for flexible cable	4	Nos
	x)		Pulleys and plummer block bearings	1	no of each type
	xi)		Plummer block with bearing for cable reel drums	1	set of each type
	R)		ELEVATOR		
	a.		Brake		
			1. Tool to brake	1	No.
			2. Fan	1	No.
			3. Magnet coil with housing pads	2	Nos.
			4. Brake pads	6	Nos.
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-VII MANDATORY SPARES	PAGE 55 OF 82	

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY Unit	
			5. Adjusting sleeve	2 Nos.	
			6. Fixed brake disc	2 Nos.	
	b.		Worm Gear		
			1. Worm gear	1 no.	
			2. 'O' ring	2 nos. of each type	
			3. Sealing ring	2 nos. of each type	
	c.		Door Front		
			1. Bearing	2 Nos.	
			2. Roller	3 Nos.	
			3. Bushing	2 Nos.	
	d.		Limit Cams		
			1. Sensor	1 No	
			2. Switch	2 Nos.	
			3. Switch arm	2 Nos.	
	e.		CAD		
			1. Guide roller	50 % of the total ones installed each type or minimum 1 no. whichever is higher	
			2. Switch	1 no.	
	f.		Sliding Door		
			1. Rollers	4 nos. of each type	
	g.		Machinery		
			1. Guide roller	2 nos.	
			2. Pinion	1 no.	
			3. Rubber inserts	6 nos.	
			4. Grove ring	6 nos.	
			5. Brake motor	1 no.	
	h.		Cable trolley		
			1. Ball bearing	2 nos. of each type	
	S)		DUST EXTRACTION SYSTEM		
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-VII MANDATORY SPARES	PAGE 56 OF 82

CLAUSE NO.	MANDATORY SPARES				
	S.N.	If Applicable (Y/N)	ITEM	QUANTITY	Unit
	1		Fan Motor	1	nos. of each type & rating
	2		Plummer Blocks	2	sets of each type
	3		Bearing of fans & motor	1	set of each type
	4		Pulley	2	nos of each type
	5		Belts	2	sets of each size
	6		Impeller and shaft of coal slurry disposal pump	1	set of each type
	7		Bearing of pumps	1	set of each type
	8		Pump Motor	1	nos of each type
	9		Motor terminal blocks with studs for all motors	1	set of each rating and type of motor
	10		Spray nozzle	10	nos of each type
	11		Solenoid valve with coil	2	nos of each type
	T)		BUCKET ELEVATOR		
	1		Buckets	10	% of total population
	2		Belt for bucket elevator	10	% of total population
	3		Linkages	20	% of total population
	Note :				
	1. Unless stated otherwise a ‘set’ means items or sub-items required for each type/size range of the assembly/ sub-assembly, required for replacement in one main equipment. It is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/ sub-assembly, these shall be considered as different types of assembly/ sub-assembly.				
	2. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quality so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.				
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-VII MANDATORY SPARES	PAGE 57 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
1.26.00	3. Whenever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid. 4. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list. 5. Price of each and every item is to be given separately. 6. Wherever rubber part viz: coupling, V belt, flexible hose etc have been used, minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied. 7. Wherever non-metallic fabric/paper filter etc have been used, minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied. 8. Any special tool required for maintenance of any of the equipment being supplied is to be included in mandatory T&P along with the equipment.			
	CONTROL AND INSTRUMENTATION (EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, COMPRESSED AIR SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems)			
	1.00.00 CONTROL AND INSTRUMENTATION			
	1.01.00 MEASURING INSTRUMENTS			
	1.01.01 (i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also. (ii) Density meter 10% or 1 no. of each type and model, whichever is more. 10% or 1 no. of each type and model, whichever is more. 1.01.02 Temp Elements along with thermo well (except winding temp elements of motor) 10% or 2 no. of each type, model & length, whichever is more.			
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-VII MANDATORY SPARES	PAGE 58 OF 82

CLAUSE NO.	MANDATORY SPARES			
	1.01.03	(i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp)	10% or 2 no. of each type and model, whichever is more.	
		(ii) Limit switches (for pneumatic and manual valves)	10% or 2 no. of each type and model, whichever is more.	
	1.01.04	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.	
	1.01.05	Vibration monitoring system		
	(i)	Sensors	10% or Minimum 2 Nos. of each type, make and model whichever is more. *if prefab cable or prefab extension cable is used same should be supplied in proportion.	
	(ii)	Power Supply Module Cards	10% or minimum 2 nos which ever is more	
	(iii)	Driver / Interface Cards & all other electronic cards.	10% or minimum 2 nos which ever is more	
	1.02.00	Continuous Emission Monitoring System (CEMS)		
	(i)	Analyzer for SO2, NOx, CO2, CO.	1 no. complete analyser of each type and model.	
	(ii)	Flue gas flow measurement instrument	1 no. complete instrument along with sender/receiver unit.	
	(iii)	Analyser for Particulate Matter	1 no. complete analyser	
	(iv)	Analyser for Mercury	1 no. complete analyser	
	(v)	O2 Analyser	1 no. complete analyser	
	(vi)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating	
	(vii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size	
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-VII MANDATORY SPARES	PAGE 59 OF 82

CLAUSE NO.	MANDATORY SPARES			
	(viii)	Temp. Sensor	20% of each type and model	
	(ix)	Heater assembly, Coolers/dryers, Pumps, etc..	20% of each type and model	
	(x)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model	
	(xi)	Solenoids	2 nos. of each type, model and rating	
	(xii)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating	
	(xiii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply	
	(xiv)	Blower assembly	1 no. of each type, size and rating.	
	1.03.00 Other FGD Analysers			
	(i)	Analysers for SO ₂ , pH	1 no. complete analyser of each type and model.	
	(ii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size	
	(iii)	Heater assembly, Coolers/dryers, pumps	20% of each type and model	
	(iv)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating	
	(v)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model	
	(vi)	Solenoids	2 nos. of each type, model and rating	
	(vii)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating	
	(viii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply	
	1.04.00 Analyzers for PT and UFRO system			
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-VII MANDATORY SPARES	PAGE 60 OF 82

CLAUSE NO.	MANDATORY SPARES			
	i) PH Analyzer (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set		
	ii) Conductivity Analyzer (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set		
	iii) Turbidity Analyzer (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set		
	iv) Residual Chlorine Analyzer (a) Sensor (b) Transmitter (c) Pre-fabricated cable with connector (d) All Chemical Reagents for 12 month operation (Supply to be staggered as per the shelf life)	1 no of each type 1 no of each type 1 set 1 set		
	v) Silica Analyzer (a) Main PCB assembly (b) Power supply Cards(if applicable) (c) Rubber Tubes & Capillary Tubes (d) Pre-fabricated cable with connector (e) Solenoid Valves (f) All Chemical Reagents for 12 month operation(Supply to be staggered as per the shelf life)	1 no of each type 1 no of each type 1 set 1 set 1 set 1 set		
	vi) Any other online analyser other than those covered above (as applicable)	1 set		
	vii) Electronic cards / PCB's for each type and model and model including power supply cards.	10%, or 2 nos. of each type and model whichever is more.		
	viii) Rubber tubes & capillary tubes of all types & sizes	100%		
	ix) Valves of each type & rating	20% or 1 No. of each type and rating		
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-VII MANDATORY SPARES	PAGE 61 OF 82

CLAUSE NO.	MANDATORY SPARES			
	x)	Filter/filter elements of all types	10%	
	1.05.00	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)		
		1. Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.	
		2. 2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.	
		3. Fittings	10% or 1 packet of each type, class, size and model whichever is more.	
		4. Purge meters	5% of each model or 1 no. whichever is more.	
		5. Filter regulators	20% of each model or 2 nos. whichever is more.	
	1.06.00	CABLES		
		1. Pre fabricated cable of each type.	10% of installed quantity	
		2. Pre fabricated cable connector of each type	10% or 1 no. of each type and model, whichever is more.	
		3. Other cables	5% of each type, pair and size of actual installed quantity	
	1.07.00	24V – DC POWER SUPPLY SYSTEM		
	1.07.01	AC/DC isolators, contactors, timers, relays	10% of each type and rating.	
	1.07.02	Fuses of each type and rating	200%	
	1.07.03	Fuse free Circuit breakers	5% of each type and rating.	
1.07.04	Electronic modules of all types	10% of each type.		
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-VII MANDATORY SPARES	PAGE 62 OF 82

CLAUSE NO.	MANDATORY SPARES एनटीपीसी NTPC		
	1.07.05 Cooling Fans 2 nos. of each type 1.07.06 Relays of all types including overload relays 10% of each type and rating 1.08.00 DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS) SI No ITEM QUANTITY 1. HMI Devices A) Work station/PC station/servers (i) OWS with licensed software 2 nos. of each type and model (ii) Server/Information Workstation with licensed software (as applicable) 1 no. of each type and model (iii) Programmer cum documentation station along with licensed software 1 no. of each type and model (iv) Keyboard 2 nos. of each type and model (v) Mouse 4 nos. of each type and model B) Printers (i) Color laser printer (A4) 1 no (ii) Print head assembly for A4 color laser printer 2 nos of each type and model C) Network Components (i) Switch/repeaters/hubs/firewalls for DDCMIS 2 nos. of each type and model (ii) Wireless equipment like power supplies ,modems, electronic modules, media converter(if applicable),connectors patch card, antenna etc. 2 nos. of each type and model (iii) Any other device/equipment not covered under above items but required to make system 2 nos. of each type and model		
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-VII MANDATORY SPARES	PAGE 63 OF 82

CLAUSE NO.	MANDATORY SPARES		
	complete. D) Miscellaneous items (i) Hard disk drive unit of each type as offered in main offer complete with disks and other accessories 4 nos. (to be divided based on main population) (ii) Bulk Storage drive unit 2 nos. of each type and model (iii) Graphic processors modules/Card for work station/server 2 nos. of each type and model (E) Any other device/items for HMIPIS system which are not covered in above items but are required to make the system complete. 1 no of each type and model 2. Cables and Connectors. (i) Prefab interconnecting cables with connectors 2 no. of each type and length. (ii) System bus cable with connectors 2 no. of each type and length. (iii) I/O bus cable with connectors for remote I/O units 2 no. of each type and length. (iv) Loose Connectors 5 nos. (sets) of each type 3. Power Supply Modules & Power Packs for control system 20% or 4 nos. of each type model and rating, whichever is more. 4. Electronic modules of each type and model for control system, Data communication system etc. (This shall include all type of cards like I/O cards, Remote I/O cards, communication/Interface cards, controller cards, CPU module or Card, logic cards, etc.) 20% or 2 Nos of each type, model and rating whichever is more subject to maximum of 20 Nos of each type. 5. Bus coupler/Interface hardware / other communication devices. 20% of each type and model or minimum 2 nos. whichever is more. 6. Relays 10% of each type and model or minimum 2 nos which ever is more 7. Batteries used for battery backup of RAMs(If applicable) 10% of each type and model or minimum 2 nos whichever is more		
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-VII MANDATORY SPARES	PAGE 64 OF 82

CLAUSE NO.	MANDATORY SPARES		
	8. Fuses	200 % of each type and rating	
	9. Cooling fans for Power supply and cabinets.	10 % of each type and model	
	10 Intelligent mini UPS for workstation server, PCs, L3 switch.	1 no. of each size and rating	
	11 For all items of Fieldbus system (including field accessories) except fieldbus cables	20% or 2 Nos. of each type, model and rating whichever is more subject to maximum of 40 Nos of each type.	
	12 Fieldbus cable	10% of total length used in the project.	
1.09.00	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS		
	1. Lime Feeders		
	1.1 Motion monitor	10% or 2 nos. whichever is more.	
	1.2 Speed pick-up	10% or 2 nos. whichever is more.	
	1.3 Torque switch (if applicable)	10% or 2 nos. whichever is more.	
	1.4 Load Cell	10% or 2 nos. whichever is more.	
	1.5 Electronic cards & Power Supply cards	10% or 2 nos. whichever is more.	
	1.6 Clutch (if applicable)	10% or 2 nos. whichever is more.	
	1.7 Local indication lamps	200 %	
	1.8Panel meters	10% or 2 nos. whichever is more.	
	1.9Limit switch assembly for lime-on- belt, no lime flow, shear pin failure, etc.	10% or 2 nos., whichever is more.	
1.10.00	CONTROL VALVES, ACTUATORS & ACCESSORIES (Following items shall be provided under this clause for all modulating control valves being supplied under this package)		
	1. Pneumatic and electro-	10% or 1 no. of each type, model and	

LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 65 OF 82

CLAUSE NO.	MANDATORY SPARES				
	hydraulic actuator assembly		rating, whichever is more.		
	2.	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve.		
	3.	Diaphragms, O' rings, seals etc. of all types make etc.	100%		
	4.	Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more		
	5.	Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more		
	6.	Positioner units (complete unit)& accessories (link assembly)	10% or 1 no. of each type whichever is more		
	7.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more		
	8.	Air lock relays	10% or 2 nos. of each type whichever is more		
	1.11.00	PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)			
	1.	Pneumatic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.		
	2.	Diaphragms, O' rings, seals etc. of all types make etc.	100%		
	3.	Limit switches (complete unit)& accessories (link assembly)	10% or 2	Nos., whichever is more	
	4.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2	Nos., whichever is more	
	1.12.00 ELECTRIC ACTUATORS				
	1	Actuators	1 no of each type and rating		
	2	Electronic PCB of all types	10% of each type & model		
	3	Absolute Encoder (replaceable part)	5% of each type & model		
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-VII MANDATORY SPARES	PAGE 66 OF 82	

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	4	Electronic Torque sensor 5% of each type & model	
	1.13.00	Uninterrupted Power supply (UPS) including Static Switch	
	SI No	ITEM	QUANTITY
	(i)	Silicon controlled thyristors, diodes and power transistors.	100 %
	(ii)	Capacitors	1 set
	(iii)	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays	10% of each type and rating.
	(iv)	Fuses of each types and rating	200%
	(v)	Fuse free Circuit breakers	5% of each type and rating
	(vi)	Electronic modules	10% of each type
	(vii)	Indication lamps	100% of each type
	(viii)	Lamp holders with series resistor, if any	10% of each type
	(ix)	Cooling Fans	2 nos. of each type
	(x)	Digital/analog panel meters/ indicators	1 no. of each type
	(xi)	Relays of all types including overload relays.	10%
	(xii)	Static Switch	10% or minimum 1 no (whichever is higher) of each type and rating
	1.14.00	Solenoid Valves	
	SI No	ITEM	QUANTITY
	(i)	Solenoid Valves	10% of each type, rating and model
	(ii)	Solenoid Valve COILS	10% of each type, rating and model
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-VII MANDATORY SPARES PAGE 67 OF 82

CLAUSE NO.	MANDATORY SPARES			
1.27.00	<u>ELECTRICAL</u>			
	1.01.00 LT Switchgear:			
	Part A:			
	S.No.	Item Description	Quantity	
	1	Complete breaker	10% of each type & rating(min 1 No)	
	2	Ammeter	2 Nos of each type, size & range	
	3	Voltmeter	2 Nos of each type, size & range	
	4	Relays	10 % of each type (min 2 Nos)	
	5	Bus bar support insulators	10 Nos.	
	Part B:			
	1	Spring charging motors	3 Nos of each type & rating	
	2	Aux. Contact set	6 sets of each type & rating	
	3	Limit switches	10 Nos of each type.	
	4	Arc chutes	10% of each type & rating	
	5	Fixed contact set	3 Nos sets of each type & rating	
	6	Moving contact set	3 Nos sets of each type & rating	
	7	Arcing contact	3 Nos sets of each type	
	8	Charging spring	2 Nos of each type & rating	
9	Current transformer	3 Nos of each type &		
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-VII MANDATORY SPARES	PAGE 68 OF 82

CLAUSE NO.	MANDATORY SPARES			
			ratio	
	10	Closing coil	6 Nos of each type & rating	
	11	Trip coil	6 Nos of each type & rating	
	12	CT for Bimetal O/L relays	3 Nos of each type & rating	
	13	Voltage transformer	3 Nos of each type & ratio	
	14	Control supply transformer	3 Nos of each type and rating	
	15	(a) Power contactor	2 Nos of each type & rating	
	16	(b) Coil of above contactor	2 Nos of each type & rating	
	17	Air break switches/ MCCBs	3 Nos of each type & rating	
	18	DP air break switches(DC)	3 Nos of each type & rating	
	19	Control & selector switches	3 Nos of each type & rating	
	20	Control fuses & neutral links	Total 50 Nos (Fuses) & 10 Nos (Neutral links), to cover all the ratings.	
	21	Indicating lamps	Total 30 Nos to cover all the types & ratings	
	22	Vertical bus bar dropper support insulators	25 Nos.	
	23	Bus duct flexible connectors (both transformer and switchgear end)	1 set for three phases of each type & size	
	24	(a) Primary disconnect in MCC (Bus bar end)(Male/female contact)	Total 15 Nos. proportionately divide for all ratings	
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-VII MANDATORY SPARES	PAGE 69 OF 82

CLAUSE NO.	MANDATORY SPARES			
	25	(b) Secondary disconnect in MCC (Cable end)	Total 15 Nos. proportionately divide for all ratings	
	26	Push buttons	10 Nos of each type	
	27	Power fuses	Total 20% proportionately divide for all ratings (min 3 Nos)	
	28	Thermal Bimetal relays	Total 5%. proportionately divide for all ratings (min 1 No)	
	29	Current transducers	2 Nos of each type & rating	
	30	Voltage transducers	2 Nos of each type & rating	
	31	Busbar aluminium flat pieces	12 meters of each type & rating	
	32	Busbar angles/formed pieces for breaker	2 Nos. of each type	
	33	Terminal blocks	12 Nos of each type & rating	
	1.02.00 LIGHTING			
	1.	LED Fixture	5 nos of each type and rating	
	2.	Lighting Panels: Timer 24 hrs	5 nos	
	3.	Lighting Control switch/ Receptacles: a) 20A receptacles with plug b) 20A rotary switch	5 nos 5 nos	
	4.	Junction Boxes: Type F-2 Terminal Strips	25 nos	
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-VII MANDATORY SPARES	PAGE 70 OF 82

CLAUSE NO.	MANDATORY SPARES			
	1.03.00 MV SWITCHGEARS			
	1	Breaker of each rating	10% of each type & rating (Min 1 No.)	
	2	Numerical relays	10% of each type (Min 2 Nos)	
	3	Aux. Relays/ Lock out relays/ Timers(if applicable)	10% of each type (Min 2 Nos)	
	4	Bus bar support insulators	12 Nos.	
	5	Energy meter of each type & range (if applicable)	1 Nos. of each type	
	6	Spring charging motor complete	2 Nos. of each type.	
	7	Current transformer of each type & ratio	3 Nos. of each type & rating	
	8	Potential transformer of each type & ratio	3 Nos. of each type & rating	
	9	Shunt trip coil	5 Nos. of each type & rating	
	10	Closing coils	5 Nos. of each type & rating	
	11	Moving contact assembly of each rating (One set means complete replacement for one breaker)	2 sets	
	12	Stationary (fixed) contact of each rating (One set means complete replacement for one breaker)	2 sets	
	13	Bus seal off bushings	3 nos. of each type & size	
	14	Limit switches	10 Nos. of each type	
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-VII MANDATORY SPARES	PAGE 71 OF 82

CLAUSE NO.	MANDATORY SPARES			
	15	Control switches	2 Nos. of each type	
	16	Selector switches	2 Nos. of each type	
	17	Isolation switch for the control supply	2 Nos.	
	18	Circuit breaker auxiliary contact assembly	6 Nos. of each type & rating	
	19	Indicating lamps with holders	20 set	
	20	(a) Fuse base and holder	12 Nos.	
		(b) Fuse link	12 Nos.	
	21	Isolating contact (fixed & moving)(one set means male & female contacts of one complete breaker)	4 sets of each rating	
	22	Terminal blocks	6 Nos.	
	23	Multiple pin plug contact assy. with cables (male & female)	6 Nos.	
	24	Inter-phase barrier	2 Nos. of each type	
	25	Vacuum Contactors with HRC fuses (if applicable)	2 Sets (One set = Three fuses)	
	26	Surge arresters	3 Nos. of each rating	
	1.04.00 DC SYSTEM			
	S.NO.	ITEM DESCRIPTION	QUANTITY (of offered type)	
	1.0	BATTERY		
	1.1	Complete dry cell	5 Nos.	
	1.2	Intercell connectors with Hardware	5 Nos.	
	1.3	Vent Plug	5 Nos.	
	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-VII MANDATORY SPARES
			PAGE 72 OF 82	

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	1.4	Electrolyte Level indicating float (For opaque containers only)	5 Nos.
	1.5	Stand Insulator (if applicable)	5 Nos.
	1.6	Cell Insulator	5 Nos.
	2.0	Battery Charger (Float cum Boost)	
	2.1	Set of Electronic Cards/ Module	1 set of each type & rating
	2.2	Set of Auxiliary relays	1 set of each type & rating
	2.3	Set of Fuse Links and Glass Fuses	3 sets of each type and rating
	2.4	Set of SCR and Diode	3 sets of each type and rating
	2.5	Rectifier Transformer	1 no of each type & rating
	2.6	Control Transformers	1 no of each type & rating
	1.05.00 MV BUSDUCT		
	a	Support insulators of each type	10 Nos.
	b	Three phase set of flexible terminal connectors for switchgear end of each type & rating	1 set
	c	Three phase set of flexible terminal connector for transformer end of each type & rating	1 set
	d	Seal off bushings of each type & rating	3 nos.
NOTE: ONE SET MEANS COMPLETE REQUIREMENT OF ONE PHASE, WHEREVER NOT SPECIFIED			
1.06.00 TRANSFORMER			
I. <u>List of Mandatory spares for Dry Type Transformers</u>			
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-VII MANDATORY SPARES	PAGE 73 OF 82

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC																																																															
	<table><tr><th>S. N.</th><th>Components</th><th>Qty (each/type)</th></tr><tr><td>1</td><td>HV Bushing (if applicable)</td><td>1 No.</td></tr><tr><td>2</td><td>LV Bushing (if applicable)</td><td>1 No.</td></tr><tr><td>3</td><td>LV Neutral Bushing (if applicable)</td><td>1 No.</td></tr><tr><td>4</td><td>Complete Winding Limb(HV and LV)</td><td>1 No. each</td></tr><tr><td>5</td><td>WTI (if applicable)</td><td>1 No.</td></tr><tr><td>6</td><td>Set of Thermister /RTD with associated leads complete for one transformer</td><td>1 Set</td></tr></table>	S. N.	Components	Qty (each/type)	1	HV Bushing (if applicable)	1 No.	2	LV Bushing (if applicable)	1 No.	3	LV Neutral Bushing (if applicable)	1 No.	4	Complete Winding Limb(HV and LV)	1 No. each	5	WTI (if applicable)	1 No.	6	Set of Thermister /RTD with associated leads complete for one transformer	1 Set	Note: 1 set consists of quantities required for 1 complete transformer. II. <u>Mandatory spares for oil filled outdoor transformers</u> <table><tr><th>S.N.</th><th>Components</th><th>Qty (each/type)</th></tr><tr><td>1.</td><td>HV Bushing with metal parts and gaskets</td><td>3</td></tr><tr><td>2.</td><td>LV bushing with metal parts and gaskets</td><td>3</td></tr><tr><td>3.</td><td>LV Neutral bushing with metal parts and gaskets</td><td>1</td></tr><tr><td>4.</td><td>WTI with contacts</td><td>1</td></tr><tr><td>5.</td><td>OTI with contacts</td><td>1</td></tr><tr><td>6.</td><td>Pressure relief device</td><td>1</td></tr><tr><td>7.</td><td>MOG</td><td>1</td></tr><tr><td>8.</td><td>Buchholz relay complete</td><td>1</td></tr><tr><td>9.</td><td>Set of gaskets</td><td>1 Set</td></tr><tr><td>10.</td><td>Set of valves</td><td>1 Set</td></tr></table> Note: 1 set consists of quantities required for 1 complete transformer. III. <u>Mandatory spares for FGD Tie transformers</u> <table><tr><th>S.No.</th><th>ITEMS DESCRIPTION</th><th>FGD TIE TRANSFORMER</th></tr><tr><td>1.</td><td>HV Bushing with metal parts and gaskets (nos.)</td><td>2*</td></tr><tr><td>2.</td><td>HV Neutral bushing with metal parts and gaskets(nos.)</td><td>1</td></tr></table>		S.N.	Components	Qty (each/type)	1.	HV Bushing with metal parts and gaskets	3	2.	LV bushing with metal parts and gaskets	3	3.	LV Neutral bushing with metal parts and gaskets	1	4.	WTI with contacts	1	5.	OTI with contacts	1	6.	Pressure relief device	1	7.	MOG	1	8.	Buchholz relay complete	1	9.	Set of gaskets	1 Set	10.	Set of valves	1 Set	S.No.	ITEMS DESCRIPTION	FGD TIE TRANSFORMER	1.	HV Bushing with metal parts and gaskets (nos.)	2*	2.	HV Neutral bushing with metal parts and gaskets(nos.)	1
	S. N.	Components	Qty (each/type)																																																															
	1	HV Bushing (if applicable)	1 No.																																																															
	2	LV Bushing (if applicable)	1 No.																																																															
	3	LV Neutral Bushing (if applicable)	1 No.																																																															
	4	Complete Winding Limb(HV and LV)	1 No. each																																																															
	5	WTI (if applicable)	1 No.																																																															
	6	Set of Thermister /RTD with associated leads complete for one transformer	1 Set																																																															
	S.N.	Components	Qty (each/type)																																																															
	1.	HV Bushing with metal parts and gaskets	3																																																															
	2.	LV bushing with metal parts and gaskets	3																																																															
	3.	LV Neutral bushing with metal parts and gaskets	1																																																															
	4.	WTI with contacts	1																																																															
	5.	OTI with contacts	1																																																															
	6.	Pressure relief device	1																																																															
7.	MOG	1																																																																
8.	Buchholz relay complete	1																																																																
9.	Set of gaskets	1 Set																																																																
10.	Set of valves	1 Set																																																																
S.No.	ITEMS DESCRIPTION	FGD TIE TRANSFORMER																																																																
1.	HV Bushing with metal parts and gaskets (nos.)	2*																																																																
2.	HV Neutral bushing with metal parts and gaskets(nos.)	1																																																																
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-VII MANDATORY SPARES																																																															
			PAGE 74 OF 82																																																															

CLAUSE NO.	MANDATORY SPARES																																			
	3.	MV bushing with metal parts and gaskets(nos.)	-																																	
	4.	LV bushing with metal parts and gaskets(nos.)	3																																	
	5.	LV Neutral bushing with metal parts and gaskets(no.)	1																																	
	6.	WTI with contacts(no.)	1																																	
	7.	OTI with contacts(no.)	1																																	
	8.	Pressure relief device(no.)	1																																	
	9.	MOG(no.)	1																																	
	10.	Buchholz relay complete(no.)	1																																	
	11.	Set of gaskets	1 Set																																	
	12.	Set of valves	1 Set																																	
	13.	Cooler fan with motor (nos.)	2																																	
	14.	Oil Pump with motor(nos.)	-																																	
	15.	Oil flow meter(nos.)	-																																	
	16.	Set of On load/Off Circuit Tap changer contacts	1 (OLTC)																																	
	17.	Air cell for conservator(no.)	1																																	
	18.	Neutral Grounding Resistor w/o supporting structure (11 kV, 11.07 ohms, 600A for 10sec.)	2 Nos.																																	
	19.	Neutral Grounding Resistor w/o supporting structure (3.3 kV, 3.32 ohms, 600A for 10sec.)	2 Nos.																																	
	* (with stand for vertical storage) Note: 1 set consists of quantities required for 1 complete transformer. 1.07.00 VFD <table><tr><td>A.</td><td>VFD TRANSFORMER (If applicable)</td><td></td></tr><tr><td>1</td><td>Primary Bushings with metal parts and gaskets(if applicable)</td><td>1 no. each rating</td></tr><tr><td>2</td><td>Secondary Bushings with metal parts and gaskets</td><td>1 no. each rating</td></tr><tr><td>3</td><td>Winding temperature indicator with alarm & trip contacts</td><td>1 no.</td></tr><tr><td>4</td><td>Oil temperature indicator with alarm & trip contacts</td><td>1 no.</td></tr><tr><td>5</td><td>Magnetic oil level gauge</td><td>1 no.</td></tr><tr><td>6</td><td>Pressure relief device</td><td>1 no.</td></tr><tr><td>7</td><td>Diaphragm for explosion vent</td><td>1 no.</td></tr><tr><td>8</td><td>Buchholz relay/sudden pressure relay</td><td>1 no.</td></tr><tr><td>9</td><td>Silca gel charge</td><td>1 no.</td></tr><tr><td>10</td><td>Pressure gauge (applicable for sealed tank)</td><td>1 no. each type</td></tr></table>			A.	VFD TRANSFORMER (If applicable)		1	Primary Bushings with metal parts and gaskets(if applicable)	1 no. each rating	2	Secondary Bushings with metal parts and gaskets	1 no. each rating	3	Winding temperature indicator with alarm & trip contacts	1 no.	4	Oil temperature indicator with alarm & trip contacts	1 no.	5	Magnetic oil level gauge	1 no.	6	Pressure relief device	1 no.	7	Diaphragm for explosion vent	1 no.	8	Buchholz relay/sudden pressure relay	1 no.	9	Silca gel charge	1 no.	10	Pressure gauge (applicable for sealed tank)	1 no. each type
	A.	VFD TRANSFORMER (If applicable)																																		
1	Primary Bushings with metal parts and gaskets(if applicable)	1 no. each rating																																		
2	Secondary Bushings with metal parts and gaskets	1 no. each rating																																		
3	Winding temperature indicator with alarm & trip contacts	1 no.																																		
4	Oil temperature indicator with alarm & trip contacts	1 no.																																		
5	Magnetic oil level gauge	1 no.																																		
6	Pressure relief device	1 no.																																		
7	Diaphragm for explosion vent	1 no.																																		
8	Buchholz relay/sudden pressure relay	1 no.																																		
9	Silca gel charge	1 no.																																		
10	Pressure gauge (applicable for sealed tank)	1 no. each type																																		
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-VII MANDATORY SPARES	PAGE 75 OF 82																																	

CLAUSE NO.	MANDATORY SPARES			
	B. VFD SYSTEM :			
	1	Electronic cards		
		(a) Control modules	1 nos. of each type & rating	
		(b) I/O module	1 nos. of each type & rating	
		(c) Power supply modules	1 nos. of each type & rating	
		(d) Gate module including gate transformer	100% of one channel	
	2	Power device (Thyristor, IGBT etc.) bridge leg	1no.(Qty. for one ph.)	
	3	Over voltage limiter and surge suppressor network	1 set	
	4	Semi conductor fuses for Power device (thyristor, IGBT etc.)	1 set	
	5	Power & Control fuse	25% of installed quantity	
	6	Control Transformer	1 nos. of each type & rating	
	7	Contactor/Breaker	1 no.	
	8	CT/VT	1 nos. of each type & rating	
	9	Indicating lamps	100% of each type & rating	
10	Auxiliary contactors & relays	1 no. of each type & rating		
12	Indicating lamp holder full set	15% of each type and colour		
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-VII MANDATORY SPARES	PAGE 76 OF 82

CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	13	Panel mounted meters		1 no. of each type & rating
	1.08.00 DIESEL GENERATOR SET			
	1(a)	Ammeter (as Used in Main Equipment)	1 No.	
	1(b)	Voltmeter (as Used in Main Equipment)	1 No.	
	2	Gaskets & packing	1 set	
	3	Valve springs	1 set	
	4	Fuel pump complete	1 set	
	5	Fuel nozzles and needles	1 set	
	6	Piston, complete with rings and rod	1 set	
	7	Piston rings(for each engine)	1 set	
	8	Flow and temperature relay of each type used	1 set	
	9	Main and end bearing shells for the diesel engine	1 set	
	10	Generator bearing sheets	1 No.	
	11	Rotor pole coil	1 No.	
	12	Battery charging rectifier diodes	4 No.	
	13	Complete rotor rectifier assembly for alternator	1 set	
	14	Fuses for the excitation diodes	3 sets	
	15	Automatic Voltage regulator	1 set	
	16	Solenoid coil for each solenoid operated valve or relay used	2 each	
	17	Instrument and indicator of each type used	1 each	
	18	Alarm and signal lamps of each type used	10% of total population	
	19	Cabinet lighting lamps(if applicable)	2 each	
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-VII MANDATORY SPARES	PAGE 77 OF 82

CLAUSE NO.	MANDATORY SPARES			
	20	Shut down coil	1 No.	
	21	Lub oil pressure relay	1 No.	
	22	Filter screen	1 No.	
	23	'O' rings injector	1 set	
	24	'O' rings breather	1 set	
	25	Magnetic Pick up	1 No.	
	26	Actuator	1 set	
	27	Air cleaner	1 set	
	30	Belts(Fan belt)	1 set	
	31	Hose bypass	1 No.	
	32	Hose turbo oil supply	2 Nos.	
	33	Hose turbo oil drain	2 Nos.	
	34	Turbo repair kit	1 No.	
	35	Over speed stop	1 No.	
	36	Resistor for diesel generator	48 Nos.	
	37	Element lube oil filter for Diesel Engine	48 Nos.	
	38	Element lube oil by-pass filter for Diesel Engine	24 Nos.	
	39	Element fuel filter for Diesel Engine	24 Nos.	
	40	Plate corr. Resistor for Diesel Engine	96 Nos.	
	41	Element air cleaner for Diesel Engine	4 Nos.	
	42	Diodes forward for alternator	3 Nos.	
	43	Diodes reverse for alternator	3 Nos.	
44	HRC fuses links of various rating	3 Nos. of each type		
45	Ammeter selector switches	1 No.		
46	Local/Remote selector switches	1 No.		
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-VII MANDATORY SPARES	PAGE 78 OF 82

CLAUSE NO.	MANDATORY SPARES		
	47	Voltmeter selector switches	1 No.
	48	Push button for trip circuit healthy test	1 No.
	49	White indication lamps for spring charged position	1 No.
	50	Alarm bell	1 No.
	51	Space heater along with control switch	1 No.
	52	Trip circuit supervision relay	1 No.
	53	Lube oil pump assembly/ rotating assembly/ impeller/shaft	1 set
	54	Starting air motor	1 No.
	55	Governing mechanism of DG set	1 No.
	1.09.00 220KV SWITCHYARD (IF APPLICABLE)		
S.NO.	ITEM DESCRIPTION	QTY (of offered type)	
I.	CIRCUIT BREAKERS		
1	One Complete breaker, 3 Poles along with drive unit, marshalling box & terminal connectors	1 no.	
2	Tripping and closing coil (one set consisting of one no. each of all types)	3 sets	
3	Spring charging motors (if applicable)	1 no.	
4	SF6 Gas filling Valve (DILO)	1 no.	
5	SF6 gas	3 Cylinders	
II.	ISOLATORS		
1	One complete pole of HCB isolator with 2 E/S along with operating mechanisms, etc.(without Structure)	1no	
III	CURRENT TRANSFORMER complete in all respects including terminal connectors.	1 no.	
V	SURGE ARRESTER complete in all respects including	1 no.	
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-VII MANDATORY SPARES
PAGE 79 OF 82			

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC																																	
	<table><tr><th>S.NO.</th><th>ITEM DESCRIPTION</th><th>QTY (of offered type)</th></tr><tr><td></td><td>terminal connector and with surge counter and lead.</td><td></td></tr><tr><td>VI</td><td>String insulator & hardware, clamp connectors, spacers and Corona bells</td><td>10% of total quantity of each type and rating</td></tr></table>	S.NO.	ITEM DESCRIPTION	QTY (of offered type)		terminal connector and with surge counter and lead.		VI	String insulator & hardware, clamp connectors, spacers and Corona bells	10% of total quantity of each type and rating																										
	S.NO.	ITEM DESCRIPTION	QTY (of offered type)																																	
		terminal connector and with surge counter and lead.																																		
	VI	String insulator & hardware, clamp connectors, spacers and Corona bells	10% of total quantity of each type and rating																																	
	1.10.00 CONTROL AND PROTECTION (IF APPLICABLE)																																			
	<table><tr><th>S.NO.</th><th>DESCRIPTION</th><th>QUANTITY</th></tr><tr><td>1.</td><td>Bay Control unit (complete with all components)</td><td>1 Nos.</td></tr><tr><td>2.</td><td>Numerical Relays comprising various bay protection units, Bus Bar and Islanding Scheme</td><td>1 No. of each type</td></tr><tr><td>3.</td><td>Energy Meter</td><td>1 no. of each type</td></tr><tr><td>4.</td><td>Operator work station (OWS) along with software, monitor, mouse, keyboard, printer etc.</td><td>1 No.</td></tr><tr><td>5.</td><td>Media cleaning solution</td><td>2 bottles</td></tr><tr><td>6.</td><td>Fuses</td><td>100% of each type and rating</td></tr><tr><td>7.</td><td>Terminal Blocks</td><td>5 nos. of each type, make, model and rating</td></tr><tr><td>8.</td><td>Interface cables containing standard length of each type of cable and its connector for each type of peripheral</td><td>2 Sets</td></tr><tr><td>9.</td><td>MCBs</td><td>50% of each type, make and model used in the system</td></tr><tr><td>10.</td><td>Relays other than numerical relays</td><td>10% of each type of total population (min 1 no.)</td></tr></table>	S.NO.	DESCRIPTION	QUANTITY	1.	Bay Control unit (complete with all components)	1 Nos.	2.	Numerical Relays comprising various bay protection units, Bus Bar and Islanding Scheme	1 No. of each type	3.	Energy Meter	1 no. of each type	4.	Operator work station (OWS) along with software, monitor, mouse, keyboard, printer etc.	1 No.	5.	Media cleaning solution	2 bottles	6.	Fuses	100% of each type and rating	7.	Terminal Blocks	5 nos. of each type, make, model and rating	8.	Interface cables containing standard length of each type of cable and its connector for each type of peripheral	2 Sets	9.	MCBs	50% of each type, make and model used in the system	10.	Relays other than numerical relays	10% of each type of total population (min 1 no.)		
	S.NO.	DESCRIPTION	QUANTITY																																	
	1.	Bay Control unit (complete with all components)	1 Nos.																																	
	2.	Numerical Relays comprising various bay protection units, Bus Bar and Islanding Scheme	1 No. of each type																																	
	3.	Energy Meter	1 no. of each type																																	
4.	Operator work station (OWS) along with software, monitor, mouse, keyboard, printer etc.	1 No.																																		
5.	Media cleaning solution	2 bottles																																		
6.	Fuses	100% of each type and rating																																		
7.	Terminal Blocks	5 nos. of each type, make, model and rating																																		
8.	Interface cables containing standard length of each type of cable and its connector for each type of peripheral	2 Sets																																		
9.	MCBs	50% of each type, make and model used in the system																																		
10.	Relays other than numerical relays	10% of each type of total population (min 1 no.)																																		
NOTE:																																				
1. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.																																				
2. Any fraction of a item shall mean the next higher integer.																																				
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-VII MANDATORY SPARES PAGE 80 OF 82																																	

CLAUSE NO.	MANDATORY SPARES		
1.28.00	3.	Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.	
	4.	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.	
	5.	In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.	
	<u>MANDATORY SPARES FOR CHIMNEY ELEVATOR</u>		
	(Qty. indicated are for one (1) No. Chimney Elevator)		
	A.	BRAKE ASSEMBLY	Qty.
	1.	Brake Assembly complete	1 No.
	B.	GEAR ASSEMBLY	
	2.	Gear Assembly complete	1 No.
	C.	DOOR FRONT	
	3.	Bearing	3 Nos.
	4.	Roller	3 Nos.
	5.	Bushing (if applicable)	2 Nos.
	D.	LIMIT CAMS	
	6.	Sensor	3 Nos.
7.	Switch arm	3 Nos.	
E.	CAB		
8.	Guide roller	100% of the total ones installed each type or min. 1	
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-VII MANDATORY SPARES
PAGE 81 OF 82			

NTPC Limited

(A Government of India Enterprise)



LOT-2 PROJECTS

PART - B

SUB-SECTION-IV-D (CIVIL WORKS)

SECTION – VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(2)-9

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D

CIVIL WORKS

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the Flue Gas Desulphurization system package for Lot-2 Projects. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.		
1.02.00	The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, ASCE, EN, CICIND and other international standards or to the best prevailing local Public Works Department practices or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed are mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.		
1.03.00	Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc. The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.		
1.04.00	For projects Simhadri stage-II (2x500MW) and Vallur (3x500MW) special provisions specified in clause no 41.00.00 shall be applicable.		
2.00.00	CLAUSE DELETED		
3.00.00	Work Description		
3.01.00	Truck Hopper, Limestone Storage hopper and Underground Tunnel Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.		
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-IV-D CIVIL WORKS	PAGE 1 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets. The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600 mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top. The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover. Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments: Chemical injection grouting for inner faces (details as specified elsewhere). Polymer modified cementitious coating on earth side face as per the following: (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication. Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches and Truck hopper.		
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-IV-D CIVIL WORKS	PAGE 2 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Earth pressure to be considered for design shall be due to earth pressure at rest (K_0) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design. A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be 0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees. Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case. Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.		
3.01A.00	Limestone Storage Silo		
	The supporting structure for silo shall be of structural steel.		
3.02.00	Overhead / Ground Conveyor Galleries and Trestles		
	Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made. Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor. The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.		
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-IV-D CIVIL WORKS	PAGE 3 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification. Cross-over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location. For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.5m above the road crest / rail top shall be provided. For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc. Thus material load per unit length of each moving conveyor shall be Rated capacity of conveyor system 1.6 X ----- x F Conveyor Belt Speed Where, F = 1700/1400 for lime & 1250/900 for gypsum		
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-IV-D CIVIL WORKS	PAGE 4 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously. Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways. a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements. b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements. End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa. For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.		
3.03.00	Transfer Houses The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.		
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-IV-D CIVIL WORKS	PAGE 5 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00	Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water. Crusher House The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery. The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water. Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification.			
	3.05.00	Control building, M. C. C. Buildings These shall be framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.		
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-IV-D CIVIL WORKS	PAGE 6 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.06.00	All air - conditioned areas, shall be provided with false ceiling system (details specified elsewhere) with under deck insulation. Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing. Pent House These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.			
	3.07.00	Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with RCC/ Brick infill wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.		
		3.08.00	Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (a.) In all M. C. C./ Control buildings	
3.09.00	Staircases, Gratings, Handrails All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases, Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Outside stairs to transfer points/crusher house shall be open type. However sheeting shall be provided at the top. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is			
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-IV-D CIVIL WORKS	PAGE 7 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling. Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.		
3.10.00	Trenches		
	All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover		
3.11.00	Cable gallery/trestles		
	Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005.		
3.12.00	Transformer Foundation		
3.12.01	Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block. The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection		
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-IV-D CIVIL WORKS
PAGE 8 OF 64			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing. The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic expansion joint. The expansion joint in the flue liner shall comprise of non-metallic material suitable for wet stack operations, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided upto the platform just below roof platform and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.. Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open		
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-IV-D CIVIL WORKS	PAGE 10 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.14.02	able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance. The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments. Design Concept Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. Imposed loading for design of all chimney components shall not be less than 5 kN/ Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document. Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings.			
	3.14.03	Wind Shield The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The analysis and design of wind shield shall be carried out as per IS 4998. The wind shield shall be analysed for cases with and without flue liner loads. Forces/stresses in the wind shield due to eccentricity effects of local loadings, insolation effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis. The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations. The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm. The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The		
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-IV-D CIVIL WORKS	PAGE 11 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm. There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings. There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level. The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening. Shell thickness between any two 10m reference levels shall not vary more than 150mm. The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm. Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure. The final design shall be checked & verified by 'Wind Tunnel Test' conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located upto distance of 20 times diameter at 2/3rd height of subject chimney, in the area or in the future expansion stage of the project, as envisaged by the owner at the time testing, shall be determined along with the other topographical features of the local area through model test.		
3.14.04	Flue Liners The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification. For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification. Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels. The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.		
3.14.05	Internal Platforms The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly		
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-IV-D CIVIL WORKS	PAGE 12 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	for impact effects. These platforms shall also be designed suitably for the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.			
3.14.06	Internal Staircase The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.			
3.14.07	Foundation The chimney foundation shall be designed as per limit state method as per IS 4998 for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/piles for any loading condition. Since chimney is a wind sensitive structure, no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 30.			
3.14.08	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner) The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC. The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanized wire mesh using MS galvanised pins and speed washer.			
3.14.09	Chimney Painting (i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) shall be painted as specified in corrosion protection clause of this specification. (ii) All steel parts embedded in concrete like bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.			
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-IV-D CIVIL WORKS	PAGE 13 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(iii) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab etc. shall be painted with epoxy phenolic coating system having total 220 microns DFT. a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. (v) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.		
3.14.11	Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual		
3.15.00	Limestone Grinding System building This shall be framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided		
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-IV-D CIVIL WORKS	PAGE 14 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.16.00 4.00.00 4.01.00 4.02.00	with roof water proofing treatment, as specified elsewhere in the Technical specification. Gypsum Dewatering Building This shall be framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Drainage & Water Supply Works Drainage System: The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically. Minimum 4 nos. down comers shall be provided in each building at corners. For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road. In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities. Internal and external water supply, drainage etc. The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications. The scope for service water supply and dust control water supply shall be as described elsewhere in the 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-IV-D CIVIL WORKS PAGE 15 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used. All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles. For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds. Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629. All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti-corrosive painting over a coat or primer. For design of building drainage system IS: 1742 shall be followed. For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.		
5.00.00	COLOUR COATED AND OTHER SHEETING WORK		
5.01.00	Material a) Wall Cladding & Roofing Material Troughed permanently colour coated sheet of approved shade and colour shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN		
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-IV-D CIVIL WORKS	PAGE 16 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. b) Metal Deck Roof Material Troughed permanently colour coated metal decking sheets shall be i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.		
5.02.00	Colour Coating Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.		
5.03.00	Design Criteria For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm. For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure		
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-IV-D CIVIL WORKS	PAGE 17 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.04.00	for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition. Fasteners Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams. The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.			
	5.05.00	Miscellaneous Details To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing. Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.		
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-IV-D CIVIL WORKS	PAGE 18 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.06.00	All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.			
	Pre-Fabricated Insulated Metal Sandwich Panels For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade. Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.			
5.07.00	Polycarbonate Sheets The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details			
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-IV-D CIVIL WORKS	PAGE 19 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.00.00	Roof Details		
6.01.00	Roof slab shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. For roof with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet.		
6.02.00	900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.		
6.03.00	Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.		
6.04.00	Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1 m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.		
6.05.00	Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows: 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C.		
6.06.00	For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.		
6.07.00	Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.		
6.08.00	Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings shall be through cage ladder as per requirement.		
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-IV-D CIVIL WORKS	PAGE 20 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.09.00	Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.		
6.10.00	The rainwater down comers shall be provided with suitable C.I. grating at inlet point.		
7.00.00	RCC Floors, Paving & Grade Slab details The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. For floors with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base. Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided. R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery. RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. Passages shall be provided inside the FGD area connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty		
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-IV-D CIVIL WORKS	PAGE 21 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.00.00	paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping. Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. However, corridors below trestle where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil. All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand An area of minimum 7.5m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings. Any functional requirement of paving for FGD facility not specifically mentioned in this document is also in scope of bidder Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level. Suitable open RCC drains shall be provided to dispose off storm water drain. Separate open RCC drains shall be provided to dispose off floor wash and plant effluents into RCC sump pits. Separate RCC sump pits shall be provided for different types of effluents. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. All drains/pits shall be provided with Heavy duty electro forged GI grating cover.		
	GRADE SLAB OF BUILDINGS AT GROUND FLOOR In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.		
	Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.		
	Brickwork and allied masonry works All brick walls shall be non - load bearing in-filled panel walls. All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.		
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-IV-D CIVIL WORKS	PAGE 22 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Only fly ash bricks shall be used in all construction. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%. Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness. Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar. 50 mm thick Damp proof course shall be provided at plinth level for all brick wall. All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.				
9.00.00	Earthing Mat 40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.				
10.00.00	CLAUSE DELETED				
11.00.00	CLAUSE DELETED				
12.00.00	ROADS All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic				
<table><tr><td>LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9</td><td>PART-B SUB-SECTION-IV-D CIVIL WORKS</td><td>PAGE 23 OF 64</td></tr></table>		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-IV-D CIVIL WORKS	PAGE 23 OF 64
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-IV-D CIVIL WORKS	PAGE 23 OF 64		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab. The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement. The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete. The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level. The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor's Density MDD using mechanical means. Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out. All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed. Unless otherwise specified, all roads shall be double lane roads. Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.		
13.00.00	CLAUSE DELETED		
14.00.00	LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations		
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-IV-D CIVIL WORKS	PAGE 24 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings. All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions. If required lifting facilities shall be provided for discharge in main / trunk drain by bidder.				
15.00.00	SEWERAGE SYSTEM The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope. Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111. Sewage pumping stations shall be provided as per IS:4111.				
16.00.00	LOADING				
16.01.00	For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the “Criteria for Earthquake Resistant Design of Structures and equipment” and the “Criteria for Wind Resistant Design of Structures and equipment” specified in the “Project Information section” of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered. <table><tr><td>a) Roofs</td><td>150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.</td></tr></table>			a) Roofs	150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.
a) Roofs	150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.				
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-IV-D CIVIL WORKS	PAGE 25 OF 64	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	b) R. C. C. floors c) Stair and balconies d) Toilet rooms e) Chequered plate floors f) Walkways (including walkways in conveyor galleries) g) Conveyor galleries h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. i) Channels / trenches j) Covers for trenches / channels k) Sumps and tanks and other underground basement type structures	500 Kgs. / Sq. M. 500 Kgs. / Sq. M. 200 Kgs. / Sq. M. 400 Kgs. / Sq. M. 300 Kgs. / Sq. M. In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes. For class 'AA' loading and checked for class A loading as per IRC standard. In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design. Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical. In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :	
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-IV-D CIVIL WORKS	PAGE 26 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	loadings with minimum factor of safety of 1.2 against buoyancy. 2500kgs. / sqm As per IRC standard (at road crossing for vehicular traffic.) L) Grating covers/ Precast RCC covers for drains, trench, sump pit in ground floor/paving area. If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design. Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.			
16.02.00	Crane load For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.			
16.03.00	Temperature load For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.			
17.00.00	DESIGN CRITERIA			
17.01.00	The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS: 456.			
17.02.00	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards.			
17.03.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – "Code of Practice for use of steel tubes in general building construction." and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively			
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-IV-D CIVIL WORKS	PAGE 27 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
17.04.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.		
17.06.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.		
17.07.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.		
17.08.00	Horizontal bracing system shall be provided at floor levels around the openings.		
17.09.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.		
17.10.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.		
17.11.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.		
17.11A.00	The loads for all railway load bearing structures e. g. tunnel, culverts and underground transfer houses etc. and the analysis and the design of these structures shall be made strictly in accordance with the provisions of Indian Railway Bridge rules (latest edition), and Indian Railway Codes of practice (latest edition) with all amendments up to the date of opening of bids. The analysis, design and detailed drawing for tunnel, underground transfer houses, culverts etc. coming directly below the railway track shall be got approved by the contractor from the concerned railway authorities. All necessary payment for the above work shall be made by the bidder to the railway authority.		
17.11B.00	Minimum clearance of 8.5m above the road crest / rail top shall be maintained at the location where the overhead conveyor gallery/cable gallery crosses road / rail line. The horizontal distance between Centre line of rail track and edge of any nearby building/structure shall not be less than 3.0m.		
17.12.00	Design of masonry walls shall be made as per IS : 1905.		
17.13.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.		
17.14.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.		
17.15.00	Foundations for all tanks shall be designed for as per IS: 803.		
17.16.00	Footings shall be so proportioned to as to minimise the differential settlement.		
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-IV-D CIVIL WORKS	PAGE 28 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS											
17.17.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.											
17.18.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.											
17.19.00	Deflection criteria The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td><td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td></tr><tr><td>2.</td><td>For other Buildings</td><td>Height/325</td></tr></table>			Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of										
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)										
2.	For other Buildings	Height/325										
17.20.00	a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325. b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification. c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500. For electric overhead cranes : 1) upto 50 t capacity : span/750 2) over 50 t capacity : span/1000 d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250 e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.											
17.21.00	a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).											
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-IV-D CIVIL WORKS									
PAGE 29 OF 64												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.22.00	b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area. a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification. b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed. c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed. d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.			
17.23.00	a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise. b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m. Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work. c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.			
17.24.00	deleted.			
17.25.00	Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.			
17.26.00	a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)			
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-IV-D CIVIL WORKS	PAGE 30 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
19.00.00	cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free. Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. Coating on RCC water retaining structures (drinking water) Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free. Fabrication All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Silo with hopper & Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded.			
	20.00.00	Electrodes		
	20.01.00	The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm.		
	20.02.00	All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.		
	20.03.00	Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.		
	20.04.00	Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.		
	20.05.00	Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.		
	20.06.00	The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.		
	20.07.00	Edge Preparation for Welding Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.		
	20.08.00	Pre Heating and Post Heating		
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-IV-D CIVIL WORKS	PAGE 32 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
	Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose. Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress. TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL <table><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or submerged arc welding</th><th>Other than low hydrogen electrode</th></tr><tr><td>Upto and including 20mm</td><td>None</td><td>None</td></tr><tr><td>Over 20mm and up to and including 40mm</td><td>20°C</td><td>Not allowed</td></tr><tr><td>Over 40mm and up to and including 63mm</td><td>66°C</td><td>Not allowed</td></tr><tr><td>Over 63mm</td><td>110°C</td><td>Not allowed</td></tr></table> Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure. TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL <table><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or</th><th>Other than low</th></tr></table>	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	None	Over 20mm and up to and including 40mm	20°C	Not allowed	Over 40mm and up to and including 63mm	66°C	Not allowed	Over 63mm	110°C	Not allowed	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or	Other than low
Thickness of thicker part at Point of welding	Welding Using																						
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode																					
Upto and including 20mm	None	None																					
Over 20mm and up to and including 40mm	20°C	Not allowed																					
Over 40mm and up to and including 63mm	66°C	Not allowed																					
Over 63mm	110°C	Not allowed																					
Thickness of thicker part at Point of welding	Welding Using																						
	Low hydrogen electrode or	Other than low																					
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-IV-D CIVIL WORKS	PAGE 33 OF 64																				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
		submerged arc welding	hydrogen electrode	
	Upto and including 20mm	None	Not Allowed	
	Over 20mm	120oC - 140°C	Not Allowed	
	Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.			
20.09.00	Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.			
20.10.00	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.			
20.11.00	All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.			
20.12.00	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.			
21.00.00	Drainage and Sewage The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings. Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.			
22.00.00	Statutory Requirements Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc. Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc. Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee. Statutory clearances and norms of State Pollution Control Board shall be followed. Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.			
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-IV-D CIVIL WORKS	PAGE 34 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
23.00.00	INSPECTION, TESTING AND QUALITY CONTROL Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used. The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.		
24.00.00	CONCRETE All R. C. C. works to the done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows: a) M25 - For all underground / sub-structural/ super-structure R. C. C. work. b) M30- For Block Foundation c) M35- For spring supported RCC deck and rail load bearing structure (if applicable) Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations. For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix. Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.		
25.00.00	Excavation, Backfilling, Disposal and Stacking of materials Details		
25.01.00	Excavation in Soil Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer.		
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-IV-D CIVIL WORKS
PAGE 35 OF 64			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose. For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.		
25.02.00	Excavation in Rock For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency. Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed. 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. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.		
25.03.00	Backfilling, Disposal and Stacking of materials Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification. However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities. The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.		
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-IV-D CIVIL WORKS	PAGE 36 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS
26.00.00	The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below: The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes. For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer. Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose. Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer. In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas. GALVANISING All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising. Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition). The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise. 27.00.00 CHEMICAL INJECTION GROUTING
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-IV-D CIVIL WORKS PAGE 37 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete. For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using repercuissive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes. After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.		
28.00.00	POLYMER MODIFIED CEMENTITIOUS COATING		
28.01.00	Materials Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.		
28.02.00	Mixing The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.		
28.03.00	Properties of Coating It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.		
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-IV-D CIVIL WORKS	PAGE 38 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
28.04.00	Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.		
	Application The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.		
	(a) For Slurry Mix A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints. The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.		
	(b) For Brush Topping Mix This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any. The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat. Rate of application of coating shall be established to achieve the required thickness.		
29.00.00	Architectural Concepts Buildings shall be architecturally treated in such a way that it presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be		
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-IV-D CIVIL WORKS	PAGE 39 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	in harmony with the surroundings. The over all composition may have straight or curvilinear profiles. Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required. Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same. All structures, buildings and facilities shall be designed as per provisions of National Building Code 2016 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable.				
29.01.00	FINISHING SCHEDULE				
29.01.01	Flooring The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base. Flooring of tiles / stone shall be fixed with cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix) Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).				
29.01.02	Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer of approved finish shade and colour to be used. Vitrified matt finish ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer.				
29.02.00	Floor finish & skirting: The nominal thickness of floor finish shall be 50 mm. Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade. (1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC.				
<table><tr><td>LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9</td><td>PART-B SUB-SECTION-IV-D CIVIL WORKS</td><td>PAGE 40 OF 64</td></tr></table>		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-IV-D CIVIL WORKS	PAGE 40 OF 64
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-IV-D CIVIL WORKS	PAGE 40 OF 64		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based). (8) Well polished 18 mm thick granite stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).		
29.03.00	Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.		
29.04.00	Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of : (i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface. (ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface. (iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.		
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-IV-D CIVIL WORKS
PAGE 41 OF 64			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
29.05.00	(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m). Acid / Alkali Resistant Treatment: Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification. The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby. Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing. Alum solution preparation tank: The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks. Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.		
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-IV-D CIVIL WORKS	PAGE 42 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.		
29.06.00	Walls		
29.06.01	All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.		
29.06.02	All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.		
29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230m thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.		
29.06.04	RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.		
29.06.05	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.		
29.06.06	The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.		
29.07.00	Plastering		
29.07.01	External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6). All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.		
29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.		
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.		
29.07.04	All plastering work shall conform to IS: 1661.		
29.08.00	Painting		
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.		
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.		
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.		
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-IV-D CIVIL WORKS	PAGE 43 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
29.08.04	Deleted			
29.09.00	Internal Finish			
	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.			
29.09.01	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.			
29.09.02	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x450mm upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.			
29.09.03	Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling.			
	The paint shall be of approved colour shade and make.			
29.10.00	External Wall Finish			
	Acrylic Smooth Exterior Paint with silicone additives (minimum two coats) over suitable primer as per manufacturer's specifications of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing, labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.			
	Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint with silicone additives.			
	The finish shall be of approved colour shade and make.			
29.11.00	Ceiling Finish			
	Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.			
29.11.01	For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.			
29.11.02	Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.			
29.12.00	Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing			
29.12.01	Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.			
29.12.02	Unless specified all doors, of air conditioned areas, entrance door of air lock lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door			
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-IV-D CIVIL WORKS	PAGE 44 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	shutters, as per IS: 2202 (Part-I) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.		
29.12.03	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.		
29.12.04	Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.		
29.12.05	All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.		
29.12.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation. Vision Panel in minimum 11 mm thick inter layered fire resistant glass shall be provided in Fire Doors.		
29.12.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.		
29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.		
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.		
29.12.10	Deleted		
29.12.11	All glazing work shall conform to IS: 3548.		
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.		
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION		
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen		
30.02.00	CPVC pipes as per IS code 15778 shall be used for internal piping works for portable water supply.		
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-IV-D CIVIL WORKS	PAGE 45 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS																													
30.03.00	UPVC Pipes as per relevant IS code shall be used for sanitary works above ground level.																													
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.																													
30.05.00	Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type). The toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area. Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below. <table><tr><th>Sl. No.</th><th>Type of Fitting / Fixtures</th><th>Gents Toilet /Ladies Toilet</th></tr><tr><td>i)</td><td>1 no wall mounted coloured glazed vitreous china European water closet with flush valve.</td><td>1 No./1 No.</td></tr><tr><td>ii)</td><td>Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures</td><td>1</td></tr><tr><td>lii)</td><td>Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone</td><td>1 No./1 No.</td></tr><tr><td>iv)</td><td>Wall to wall mirror minimum 900 mm high (minimum 6mm thick float glass) including all fittings</td><td>1 No./1No.</td></tr><tr><td>v)</td><td>Stainless steel Towel Rail 600mm Long x 20 mm dia.</td><td>1 No. /1 No.</td></tr><tr><td>vi)</td><td>Stainless steel Liquid soap holder cum dispenser with requisite fittings.</td><td>1 No.</td></tr><tr><td>vii)</td><td>Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.</td><td>1</td></tr><tr><td>viii)</td><td>Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type</td><td>1 No.</td></tr></table> One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner. Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above. Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers. Janitor room. Adequate space shall be provided. Provision for installation of water cooler.			Sl. No.	Type of Fitting / Fixtures	Gents Toilet /Ladies Toilet	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No./1 No.	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	lii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone	1 No./1 No.	iv)	Wall to wall mirror minimum 900 mm high (minimum 6mm thick float glass) including all fittings	1 No./1No.	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No. /1 No.	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.
Sl. No.	Type of Fitting / Fixtures	Gents Toilet /Ladies Toilet																												
i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No./1 No.																												
ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1																												
lii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone	1 No./1 No.																												
iv)	Wall to wall mirror minimum 900 mm high (minimum 6mm thick float glass) including all fittings	1 No./1No.																												
v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No. /1 No.																												
vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.																												
vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1																												
viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.																												
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-IV-D CIVIL WORKS																											
PAGE 46 OF 64																														

CLAUSE NO.	TECHNICAL REQUIREMENTS
30.06.00	All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.
30.07.00	The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, lifting facilities for connecting to the manhole of owner's sewer line shall be in bidder's scope.
30.08.00	Miscellaneous Architectural Items (a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers. (b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc. (c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided. (d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of 600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m. (e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements. (f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3). (g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4). (h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.
31.00.00	CORROSION PROTECTION

CLAUSE NO.	TECHNICAL REQUIREMENTS		
31.01.00	GENERAL		
(a)	All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944.		
	Painting system for steel surfaces embedded in Concrete is given separately.		
(b)	All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer.		
(c)	All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members.		
d)	Painting scheme shall be resubmitted by the Bidder for approval of employer.		
31.02.00	PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:		
a)	For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).		
b)	All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.		
31.03.00	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)		
a)	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.		
b)	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.		
c)	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.		
	Notes:		
1.	For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time.		
2.	The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of		
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-IV-D CIVIL WORKS	PAGE 48 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. 3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. 4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.		
31.04.00	COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER. a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629. b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.		
31.05.00	Gratings All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.		
31.06.00	Hand Railings and Ladders All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.		
31.07.00	Sea Worthiness All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.		
31.08.00	For Reinforced Concrete Work. i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts. ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc., Bidder shall furnish the details of corrosion protection measures.		
32.00.00	Miscellaneous		
32.01.00	Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.		
32.02.00	Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail		
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-IV-D CIVIL WORKS	PAGE 49 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.		
32.03.00	Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.		
32.04.00	Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.		
32.05.00	The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.		
32.06.00	Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
33.00.00	SHOTCRETING		
33.01.00	General Requirements		
33.01.01	Generally, shotcreting shall be done in accordance with IS : 9012.		
33.01.02	Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.		
33.01.03	Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.		
33.01.04	Clear cover to reinforcement mesh shall not be less than 15 mm.		
33.01.05	Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
33.02.00	Material Generally, the materials shall be in accordance with aggregates specification given hereunder.		
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-IV-D CIVIL WORKS	PAGE 50 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
33.02.01	Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.		
33.02.02	Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.		
33.02.03	The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.		
33.03.00	Application		
33.03.01	After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.		
33.03.02	The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.		
33.03.03	A uniform pressure of not less than 3 Kg/cm ² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.		
33.03.04	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.		
33.03.05	As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38 ⁰ C during placing of concrete.		
34.00.00	VIBRATION ISOLATION SYSTEM These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.		
34.01.00	Supporting Arrangement		
34.01.01	For Crushers:		
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-IV-D CIVIL WORKS	PAGE 51 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
34.01.02	The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building. The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.			
	The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.			
	34.02.00 Scope of Work			
	34.02.01 Scope of work shall include the following :			
	(a.) Engineering (1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment. (2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc. (3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure. (4.) Drawings showing embedments and their locations and details on the R. C. C. top deck. (5.) Drawings showing blockouts, recesses etc. on the top deck. (6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials. (b.) Supply including packing and transportation to site			
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-IV-D CIVIL WORKS	PAGE 52 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform. (7.) Proposed erection strategy of the entire system.		
34.03.00	Design Requirements for Crusher Foundation		
34.03.01	Dynamic Analysis Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis. Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria. Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.		
34.03.02	Isolation Efficiency The vibration isolation system shall be designed for about 90 % isolation efficiency.		
34.03.03	De-coupling A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.		
34.03.04	Frequency Criteria The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.		
34.03.05	Unbalance Forces for Crushers Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.		
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-IV-D CIVIL WORKS	PAGE 54 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
34.03.06	(a.) Balance quality grade Q 40 as per VDI 2060 - 1966. (b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher. (c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher. Amplitude Criteria for Crushers The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions. 1) Operating speed of 750 RPM (a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966. (b.) 300 microns in case of a one hammer broken condition. (c.) Amplitudes need not be checked for a three hammer broken condition. 2) Operating speed of 450 RPM (a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966. (b.) 400 microns in case of a one hammers broken condition. (c.) Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vetor may be considered while superimposing the modes.			
	34.03.07	Unbalance force and Amplitude Criteria The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.		
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-IV-D CIVIL WORKS	PAGE 55 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
34.03.08	Transient Resonance			
	Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.			
34.04.00	Strength Criteria			
	The following criteria shall apply for the design of top deck :			
	(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.			
	(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together			
	(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.			
	(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.			
	(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.			
	(f.) Fatigue need not be considered for the three hammer broken condition.			
	(g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.			
	34.05.00	Approval of Designs and Drawings		
All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.				
34.06.00	Standards			
	Latest revisions of the following Codes shall be used for the design of the crusher foundations.			
	(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.			
	(b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency.			
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-IV-D CIVIL WORKS	PAGE 56 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures). (d.) DIN 4024 Machine Foundations : Flexible supporting structures for machines with rotating masses. (e.) DIN 2089 Helical Compression Springs out of round wire and rod; calculation and Design. (f.) DIN 2096 Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs. (g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines. (h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies.not be permitted to exceed 38°C during placing and curing		
35.00.00	Packaging and Transportation. All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.		
36.00.00	Plant Life The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.		
37.00.00	PTFE (Poly Tetra Fluoroethylene) Bearing The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.		
38.00.00	TESTS FOR MATERIAL / WORKMANSHIP		
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-IV-D CIVIL WORKS	PAGE 57 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS
	All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.
39.00.00	MATERIALS
39.01.00	For Civil, Structural and Architectural works
	Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification. The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less than the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.
39.02.00	Structural steel
	Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.
39.02.01	Mild Steel
	a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.
39.02.02	Medium and High Tensile Steel
	Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.
39.03.00	Cement

CLAUSE NO.	TECHNICAL REQUIREMENTS		
39.03.01	Fly ash based portland pozzolana cement conforming to IS:1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code.		
39.03.02	Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Spring supported decks of limestone crusher b) RCC for Chimney shell. The grade of cement shall be Grade 43 for OPC conforming to IS:269.		
39.03.03	In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS:3812(Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.		
39.04.00	Reinforcement steel shall conform to: a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062. b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.		
39.05.00	Aggregates a) Coarse Aggregate Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. b) Fine Aggregate Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116. c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed. The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results		
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-IV-D CIVIL WORKS	PAGE 59 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS												
39.06.00	are not satisfactory, shall be submitted to the Engineer for his review, in a report form. In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of Lime stone crusher decks, Mills, Fans and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.												
	NUTS AND BOLTS M.S. Nuts and Bolts shall conform to IS:1363,IS:1364, IS:1367. High tensile fixing with bolts and nuts shall respectively be as per IS:3757 and IS:6623. Washers shall conform to IS:5369, IS:5370, IS:5372, IS:5374, IS:6610, IS:6649, as appropriate.												
40.00.00	CODES AND STANDARDS All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list. In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail. Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below <table><tr><td>IS : 383</td><td>Specification for coarse and fine aggregates from natural sources for Concrete.</td></tr><tr><td>IS : 432</td><td>Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.</td></tr><tr><td>IS : 456</td><td>Code of practice for plain and reinforced concrete.</td></tr><tr><td>IS : 458</td><td>Specification for concrete pipes.</td></tr><tr><td>IS : 516</td><td>Method of test for strength of concrete.</td></tr></table>			IS : 383	Specification for coarse and fine aggregates from natural sources for Concrete.	IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.	IS : 456	Code of practice for plain and reinforced concrete.	IS : 458	Specification for concrete pipes.	IS : 516	Method of test for strength of concrete.
IS : 383	Specification for coarse and fine aggregates from natural sources for Concrete.												
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.												
IS : 456	Code of practice for plain and reinforced concrete.												
IS : 458	Specification for concrete pipes.												
IS : 516	Method of test for strength of concrete.												
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-IV-D CIVIL WORKS	PAGE 60 OF 64									

CLAUSE NO.	TECHNICAL REQUIREMENTS		
		IS : 800 Code of practice for use of structural steel in general building construction. IS : 814 Specification for covered electrodes for metal arc welding for weld steel. IS : 816 Code of practice for use of metal arc welding for general construction. IS : 817 Code of practice for training and testing of metal arc welders. IS : 875 (Pt. I to V) Code of practice for design loads other than earthquake) for buildings and structures. IS : 1038 Steel doors, windows and ventilators. IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1361 Steel windows for industrial buildings. IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement. IS : 1892 Code of practice for subsurface investigation for foundation. IS : 1893 Criteria for earthquake resistant design of structures. IS : 1904 Code of practice for design and construction of foundations in soils; general requirements. IS : 1905 Code of practice for structural safety of buildings - Masonry walls. IS : 1948 Specification for aluminium doors, windows and ventilators. IS : 2062 Steel for general structural purposes. IS : 2131 Method of standard penetration test for soils. IS : 2212 Code of practice for brickwork. IS : 2645 Specification for Integral cement water proofing compounds. IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils - determination for water content etc code of practice for earth work on canals. IS : 2911 Code of practice for design and construction of pile foundations. (Part-1/Sec.1) Driven cast in situ concrete piles.	
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-IV-D CIVIL WORKS PAGE 61 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(Part-1/Sec.2)	Bored cast-in-situ concrete piles.	
	(Part-IV)	Load test on piles.	
	IS : 2974 (Part - I TO V)	Code of practice for design and construction of machine foundations.	
	IS : 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.	
	IS : 3658	Code of practice for liquid penetrant flaw detection.	
	IS : 3664	Code of practice for ultra sonic testing by pulse echo method.	
	IS : 4326	Code of practice for earthquake resistant design and construction of buildings.	
	IS : 4990	Specification for plywood for concrete shuttering work.	
	IS : 5624	Specification for foundation bolts.	
	IS : 7215	Tolerances for fabrication steel structures.	
	IS : 8112	Specification for 43 grade Ordinary Portland Cement.	
	IS : 9103	Specification for admixtures for concrete.	
	IS : 9595	Code of procedure of manual metal arc welding of mild steel.	
	IS : 10262	Recommended guidelines for concrete mix design.	
	IS : 13311	Method of non - destructive testing of concrete.	
	IS : 13755	Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)	
	ASTM 898 -89	Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.	
	AS/NZS 2728	Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements.	
	AS : 1365	Standards for steel manufacturing.	
	AS : 1397	A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated.	
	AS : 3566	Self drilling screws for building and construction industry.	
	IRC : 37	Guidelines for the design of flexible pavements.	
	-	Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated.	
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-IV-D CIVIL WORKS PAGE 62 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS			
41.00.00	Indian Explosives Act. 1940 as updated.			
	SPECIAL PROVISIONS FOR SIMHADRI-II (2X500 MW) AND VALLUR (3X500MW) PROJECTS.			
	Item	Clause No.	General Provision (for all projects except Simhadri & Vallur)	Special Provisions for Simhadri & Vallur Projects
	Corrosion Protection	31.01.00 (a)	...Corrosive Category C3...	...Corrosive Category C5...
		31.03.00 (b)	...Polyamide cured epoxy of minimum 100 micron DFT...	...Polyamide cured epoxy of minimum 180 micron DFT...
	Colour coated and Other Sheetting works	5.01.00, 5.06.00	...Zinc coating to class Z275/ aluminium-zinc alloy coating to class AZ150...	...Zinc coating to class Z350/ aluminium-zinc alloy coating to class AZ200...
		5.01.00 (b)	...Zinc coating to class Z275...	...Zinc coating to class Z350...
	Concrete (RCC)	24.00.00 a) 7.00.00 14.00.00 21.00.00	M25...	M30... (Refer notes below)
	Concrete (PCC)	6.04.00 6.05.00 6.06.00 6.07.00 6.09.00	M-15...	M20...
	Cement	39.03.01	... portland pozzolana cement conforming to IS:1489 (Part-1) shall be...	... portland pozzolana cement conforming to IS:1489 (Part-1) / Portland slag cement conforming to IS:455 shall be....
		39.03.03	In place of fly ash based portland pozzolana cement, II). Percentage... ..fly ash mix with cement.	DELETED
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-IV-D CIVIL WORKS PAGE 63 OF 64

CLAUSE NO.	TECHNICAL REQUIREMENTS																																					
	<table><tr><td>Reinforcement Steel</td><td>39.04.00 (b)</td><td>High yield strength deformed TMT steel bars of grade Fe 500</td><td>High yield strength deformed Corrosion resistant grade TMT steel bars of grade Fe 500</td></tr></table>				Reinforcement Steel	39.04.00 (b)	High yield strength deformed TMT steel bars of grade Fe 500	High yield strength deformed Corrosion resistant grade TMT steel bars of grade Fe 500																														
	Reinforcement Steel	39.04.00 (b)	High yield strength deformed TMT steel bars of grade Fe 500	High yield strength deformed Corrosion resistant grade TMT steel bars of grade Fe 500																																		
	Note:																																					
	1. Provisions as mentioned under special requirements in Soil data & foundation system, of Project Information chapter (Part A of section VI of technical specifications), are also applicable for RCC works below ground. 2. The environmental exposure conditions corresponding to type “Severe” as per Table-3 of IS:456 shall be considered for all concrete. The minimum clear cover to main reinforcement shall be as below:																																					
<table><tr><th>Sl No</th><th>Item</th><th>Top (mm)</th><th>Bottom (mm)</th><th>Side (mm)</th></tr><tr><td>1.</td><td>Foundations, Wall base slab, pedestals</td><td>60</td><td>60</td><td>60</td></tr><tr><td>2.</td><td>Plinth Beams</td><td>50</td><td>50</td><td>50</td></tr><tr><td>3.</td><td>Columns</td><td>60</td><td>--</td><td>60</td></tr><tr><td>4.</td><td>Floor/Roof/Tie/Lintel Beams</td><td>50</td><td>50</td><td>50</td></tr><tr><td>5</td><td>Floor / Roof slab and sun-shades / facia</td><td>35</td><td>35</td><td>35</td></tr><tr><td>6.</td><td>Trenches / Pits</td><td>40</td><td>60</td><td>60</td></tr></table>				Sl No	Item	Top (mm)	Bottom (mm)	Side (mm)	1.	Foundations, Wall base slab, pedestals	60	60	60	2.	Plinth Beams	50	50	50	3.	Columns	60	--	60	4.	Floor/Roof/Tie/Lintel Beams	50	50	50	5	Floor / Roof slab and sun-shades / facia	35	35	35	6.	Trenches / Pits	40	60	60
Sl No	Item	Top (mm)	Bottom (mm)	Side (mm)																																		
1.	Foundations, Wall base slab, pedestals	60	60	60																																		
2.	Plinth Beams	50	50	50																																		
3.	Columns	60	--	60																																		
4.	Floor/Roof/Tie/Lintel Beams	50	50	50																																		
5	Floor / Roof slab and sun-shades / facia	35	35	35																																		
6.	Trenches / Pits	40	60	60																																		
For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.																																						
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-IV-D CIVIL WORKS	PAGE 64 OF 64																																		

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
1.	VI/A	II-A1	TSTPS	GLP	Drawing No. 4330-999-POC-F-002 Rev. 5	Drawing No. 4330-999-POC-F-002 Rev. 6 is issued as per <u>Annexure-I</u> .
2.	VI/A	II-A1	TSTPS	Existing Plant Drawings	-	Additional Drawings of Existing Plant issued as per <u>Annexure-II</u>
3.	VI/A	II-A1	TSTPS	Project Information		Climatological Table issued as per <u>Annexure-III</u>
4.	VI/A	II-A2	Simhadri	GLP	Drawing No. 3530-999-POC-F-001 Rev. 5	Drawing No. 3530-999-POC-F-001 Rev. 6 is issued as per <u>Annexure-IV</u> .
5.	VI/A	II-A2	Simhadri	Project Information		Climatological Table issued as per <u>Annexure-V</u>
6.	VI/A	II-A2	Simhadri	Existing Plant Drawings	-	Additional Drawings of Existing Plant issued as per <u>Annexure-VI</u>
7.	VI/A	II-A3	Sipat	GLP	Drawing No. 9518/9545-999-POC-F-001 Rev. 13	Drawing No. 9518/9545-999-POC-F-001 Rev. 14 is issued as per <u>Annexure-VII</u>
8.	VI/A	II-A3	Sipat	Existing Plant Drawings	-	Additional Drawings of Existing Plant issued as per <u>Annexure-VIII</u>
9.	VI/A	II-A4	Vallur	Existing Plant Drawings	-	Additional Drawings of Existing Plant issued as per <u>Annexure-IX</u>
10.	VI/A	II-A5	Bhilai	GLP	Drawing No. B/TS/PLOT Rev. 1	Revised Drawing No. B/TS/PLOT Rev. 1 is issued as per <u>Annexure-X</u>
11.	VI/A	II-A7	Rourkela	GLP	Drawing No. PE-DG-427-100-M001 Rev. 9	Drawing No. PE-DG-427-100-M001 Rev. 10 is issued as per <u>Annexure-XI</u>

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
12.	VI/A	VI	23 of 27	6.00.00	The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code.	The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code.
13.	VI/B	I-M1	7 of 52	3.03.01	The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. Guillotine gate type damper shall be provided by the Contractor before the suction of each Booster fan.	The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. Guillotine gate type dampers shall be provided by the Contractor before the suction and discharge of each Booster fan.
14.	VI/B	I-M1	24 of 52	6.05.10	New Clause Added	The design and manufacturing of wet ball mill shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.
15.	VI/B	I-M1	27 of 52	7.04.11	New Clause Added	The design and manufacturing of vacuum belt filter shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.
16.	VI/A	V	1-8 OF 21	1.00.00 2.00.00 3.00.00	Salient Design Data Guarantee Point	Pressure at Terminal Point before Booster Fan Suction shall be Zero (0) mmwc at Guarantee Point Condition for all the projects
17.	Section-VI, Part-B	M6	6 of 41	4.04.00	Dust Extraction System Type: Venturi Scrubber Type Location: • Belt Feeder after crusher • Feeder at crusher house • Limestone storage shed • Gypsum shed	Dust Extraction System Type: Dry Type Bag Filter Location: • Truck un-loading points • Junction Tower (limestone/gypsum discharge & receipt point) • Limestone crusher house (including belt feeder & vibrating feeder) • Lime stone / gypsum shed/silo
18.	Section-VI, Part-B	M6	28 of 41	1.07.00	Limestone feeding arrangement – Through vibrating screed feeder (However the crusher zero passage of limestone through screen)	Limestone feeding arrangement – Through vibrating feeder (However the crusher zero passage of limestone through screen)

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.		
19.	Section-VI, Part-B	M6	3 of 41	3.02.00	Gypsum from storage shed shall be loaded to user's trucks using front end loader/payloader.	Gypsum from storage shed shall be loaded to user's trucks using front end loader/payloader. The storage shed shall be enclosed type so that no dry gypsum could come out of shed.
20.	Section-VI, Part-B	M6	3 of 41	3.02.00	Alternatively, Gypsum can be stored in Eurosilos/equivalent (minimum 2 Nos. to be provided).	Alternatively, Gypsum can be stored in Eurosilos/equivalent (minimum 2 Nos. with 7 days storage each OR one No. with 7 days storage alongwith one bypass arrangement and storage shed for minimum 4 days for gypsum storage. The storage shed shall have facility to transfer gypsum to trucks by owner.
21.	Section-VI, Part-B	M6	3 of 41	3.02.00	Silos shall have a drainage system at bottom. Silo shall permit to unload gypsum directly into trucks.	Silos shall have a drainage system at bottom. Silo shall permit to unload gypsum directly into trucks. Further, conventional elevator (capacity of 8 persons) shall be provided for Silos to access the various operating/maintenance elevation/floors of silos & its top floors.
22.	Section-VI, Part-A	VI	22 of 27	5.00.00	-	xxxiv) Power consumption for lime stone unloading, conveying, crushing, storage & reclaiming system (Single Stream) except lighting, hoists, sampling unit, sump pumps, elevators, DE, ventilation, SW System, Potable water system. Duty factor for above system to be considered as 0.15. Accordingly, Pu for the same shall be duty factor x power consumption xxxv) Power consumption of Gypsum conveying system (Single Stream) except lighting, hoists, sampling unit, sump pumps, elevators, DE, Ventilation, SW System, Potable Water System.

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
23.	Section-VI, Part-A	VII	54 of 82	O)	DUST SUPPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER	SERVICE WATER, POTABLE WATER, COOLING WATER
24.	Section-VI, Part-A	VII	54 of 82	O)	Sl. No. h), i), j) & n)	Deleted
25.	VI/A	VI	19 OF 30	4.02.00(X VI)(a)	Each clarifier unit of PT-CW system shall be guaranteed for an effluent capacity of not less than 280 Cu.M/hr meeting the effluent quality as mentioned below.	Each clarifier unit of PT-CW system shall be guaranteed for an effluent capacity of not less than 460 Cu.M/hr meeting the effluent quality as mentioned below.
26.	VI/A	II-A4	33 OF 37	Table-4 Sea water Analysis	Sea water analysis	Sea water analysis. REFER Annexure-XII
27.	VI/A	III-A4	6 of 88	6.03.00(g)	Interconnection between the clarified water outlet channel and outlet channel Existing clarifier.	-----DELETED-----
28.	VI/A	III-A4	48 OF 88	3.A2.8-ULTRA-FILTRATION(UF) SYSTEM	Design permeate water quality--- Turbidity < 1.0 NTU, SDI < 2 for 100% of time.	Design permeate water quality--- Turbidity < 1.0 NTU, SDI < 3 for 100% of time.
29.	VI/A	III-A4	2 OF 88	4.01.00(d) (e) (f)	(d) 4 x 50% (3 working + 1 standby) capacity of plate type heat exchangers. (e) 5 x 50% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 4 x 50% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives	(d) 4 x 33.33% (3 working + 1 standby) capacity of plate type heat exchangers. (e) 5 x 33.33% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 4 x 33.33% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
30.	VI/A	III-A4	3 OF 88	6.01.00(d) (e) (f)	(d) 7 x 50% (6 working + 1 standby) capacity of plate type heat exchangers. (e) 8 x 50% (6 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 7 x 50% (6 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.	(d) 7 x 16.66% (6 working + 1 standby) capacity of plate type heat exchangers. (e) 8 x 16.66% (6 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 7x16.66% (6 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.
31.	VI/A	III-A4	7 OF 88	9.03.00(K) 9.04.009(c) (d)	(K) 6 x 50% (4 Working + 2 standby) capacity auxiliary cooling water pumps, its drives,----- -----& isolation valves at the discharge and discharge pipe line to PHE etc. (c) 5 x 50% (4 working + 1 standby) capacity of plate type heat exchangers. (d) 5 x 50% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.	(K) 6 x 25% (4 Working + 2 standby) capacity auxiliary cooling water pumps, its drives,----- -----& isolation valves at the discharge and discharge pipe line to PHE etc. (c) 5 x 25% (4 working + 1 standby) capacity of plate type heat exchangers. (d) 5 x 25% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.
32.	VI/A	III-A4	28 OF 88	10.06.00 (25)	25) Required number of lifting bar, dial type load indicator, electrically operated mono rail hoists for handling chlorine tonners,	-----DELETED-----
33.	SECTION-VI/ Part-A	V	13 of 21	6.02.01a(i) i)	a) FGD Control Room Building i) Air Cooled condensing units Air conditioners: 2X100% ii) AHU (with VVVF): 2 X 100%	a) FGD Control Room Building i) Air Cooled condensing units Air conditioners: 2X100% ii) AHU : 2 X 100%

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
34.	VI/A	V	13 of 21	6.02.01 (b)	100% standby shall be provided for area served by Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners for all other control rooms covered in the scope of this package.	(N+1) standby configuration shall be provided for area served by Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners for all other control rooms covered in the scope of this package. Here N stands for number of working ACs
35.	VI	Part E		SLD	0011-109(2)-POE-J-001/C Rev-B	0011-109(2)-POE-J-001/C Rev-C as Annexure-XIII
36.	VI	II-E6	10 of 23	4.04.04	Power and control cables shall be laid...Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation.....	Power and control cables shall be laid...Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every one metre. All multicore cables shall be laid in touching formation.....
37.	VI	II-E4	3 OF 6	3.01.00	a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). b) 1.1KV grade PVC power cables shall have aluminium conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).	a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured, PVC outer-sheathed conforming to IS:7098. (Part-I). b) 1.1KV grade PVC power cables shall have aluminium conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured, PVC outer-sheathed conforming to IS:1554 (Part-I).
38.	VI	II-E5	3 of 6	3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).
39.	VI	E20	11 of 19	5.05.01	Dummy panels.....during detailed engineering.	Deleted

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.		
40.	VI	A	4 of 8	1.06.00(f)	ABT based energy....owner supplied energy meters.	ABT based energy meters and integration with existing metering system.
41.	SECTION – VI, PART-A	SUB-SECTION-III-C C&I SYSTEM	19 of 19	15.00.00	---	15.00.00 Requirement for FGD control room and RIO room FGD Control room and Remote I/O room (if applicable) shall be air conditioned and battery room shall be air ventilated. False ceiling shall be provided in Control room / RIO room. The following guidelines shall be followed for control system cabinet placement in Control room / Remote I/O room: i) Inter panel spacing-1200 mm ii) Clearance from back wall-1200 mm iii) Clearance from front wall-1200mm iv) Clearance from side wall-1000mm The above clearances are the minimum requirement and may increase with increase in door swing of cabinets. Cable trench to be provided for FGD CR & Remote I/O Room. In case CR/ RIO Room is located above ground floor, cable vault shall be provided. False floor to route cables is not permitted.
42.	SECTION – VI, PART-A	SUB-SECTION-III-C C&I SYSTEM	12 of 19	3.03.02	Bidder shall connect analysers instruments of his scope and provide single point/port for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer.....	Bidder shall connect analysers instruments of his scope and provide single point/port in FGD Control room for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer.....
FGD SYSTEM PACKAGE LOT-2 PROJECTS				AMENDMENT NO. CS-0011-109(2)-9-AMDT-03		BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
43.	SECTION – VI, PART-B	SUB-SECTION-I-M6	14 of 76	4.9.6	Specification of the Vibration Monitoring System	Clause deleted
44.	Part-E (Tender Drawings), Section-VI	Scheme of FGD-Absorber System (DRG No: 0011-109(2)-POM-A-001. Rev. No: A.)	Sheet 1 of 3		In the referred tender drawing (Sheet 1 of 3), in FGD Bypass Damper's Seal Air System Flow Switch (FS), Temperature Switch (TS) and Temperature Transmitter (TT) is shown.	In the referred tender drawing (Sheet 1 of 3), in FGD Bypass Damper's Seal Air System Flow Switch (FS), Temperature Switch (TS) and Temperature Transmitter (TT) stands deleted . Only Pressure Transmitters (PT) are applicable at the discharge line of FGD Bypass Damper seal air system.
45.	VI/ PART-B	IV-D		39.05.00 (b)	b) Fine Aggregate Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116.	Fine Aggregate Fine aggregate shall consist of natural sand/ crushed sand and shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116. However, in case of chimney shell construction, natural sand conforming to IS: 383 shall only be used.

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
46.	VI/ PART-B	IV-D		31.06.00	Hand Railings and Ladders All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.	Hand Railings and Ladders All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736.
47.	VI/ PART-B	IV-D		31.01.00 d)	Painting scheme shall be resubmitted by the Bidder for approval of employer.	Delete
48.	VI/ PART-B	IV-D		7.00.00	The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. For floors with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet	The floor slabs shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
49.	VI/ PART-B	IV-D		7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. For floors with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
50.	VI/ PART-A	II- A1/A2/ A3/A4/ A5/A6/ A7	16 of 34/ 13 of 29/ 12 of 29/ 14 of 37/ 13 of 30/ 15 of 36/ 13 of 29/	7.02.03 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.	Routine pile load tests to be performed on 0.5% of the total number of piles provided for each diameter/allowable capacity. 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. In case agency wish to carry out only static routine vertical load test on 0.5% of total number of piles, he may adopt the same.
51.	VI/ PART-A	II- A1/A2/ A3/A4/ A5/A6/ A7	22 of 34/ 19 of 29/ 19 OF 29/ 24 of 37/ 20 of 30/ 25 of 36/ 21 of 29	Annexure	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.	Bidder is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-2.
52.	VI/ PART-A	II- A3/A4/ A5/A6/ A7	-	Annexure-III	-	Amendment added with clause 7.00.00, II-A3/A4/A5/A6/A7, of Tech. Specification. Available additional data provided as per Annexure-XIV .
FGD SYSTEM PACKAGE LOT-2 PROJECTS				AMENDMENT NO. CS-0011-109(2)-9-AMDT-03		BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAU SE NO.		
53.	VI/ PART-A	II-A4	-	Annex- ure-IV	BH-93 co-ordinate	Please read co-ordinate of BH-93 as 1656N 813W

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.		
54.	VI/ PART-A	II- A1/A2/ A3/A4/ A5/A6/ A7	12 of 34/ 9 of 29/ 9 of 29/ 11 of 37/ 10 of 30/ 11 of 36/ 10 of 29	7.02.01 e)	Before execution of work the bidder shall ensure that there is no obstruction to underground/over ground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.	Before execution of work the bidder shall ensure that there is no obstruction to underground/over ground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. For underground facilities survey, Ground Penetration Radar (GPR) may be used.

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
55.	VI/ PART-A	II-A4	11 of 37	7.02.01 b	The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.	Minimum 500mm thick compacted moorum/Non-Expansive Soil shall be provided replacing existing ash/soil below the roads, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 . For ground floor slab, where grade slab is the part of buildings, the ground improvement with stone column shall be carried out below the entire buildings/structures. Further, Ground improvement with stone column shall be carried out minimum d/2 distance beyond the footprint of buildings (minimum 2 rows beyond the building footprint), where d is the depth of improvement.
56.	VI/ PART-B	IV-D	3.14.09 Para 7	13 of 68	(v) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.	(iv) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iii) above in alternate bands of 'signal red' and 'bright white' colours.

FGD SYSTEM PACKAGE LOT-2 PROJECTS	AMENDMENT NO. CS-0011-109(2)-9-AMDT-03	BID DOCUMENT NO. CS-0011-109(2)-9

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

SL NO	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
1.	VI/ A	III-C	13 of 19	3.06.01	Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month	We presume that the CEMS Equipment supplier is eligible for delivering the services of Comprehensive AMC (CAMC). Kindly confirm.	Specification requirement mentioned in clause 3.06.01 is clear. Bidder to comply with the specification requirement.
2.	VI/ A	III-C	18 of 19	13.00.00	The minimum quantity per unit of furniture envisaged in FGD control room is as mentioned below:	As per the description given in the specification, there is only one FGD Control room common for all the Units. We presume the quantity of furniture indicated in this clause is common for all the Units. Kindly clarify and confirm.	Bidder's understanding is not correct. Bidder to supply minimum quantity of furniture as mentioned in the specification on per generating unit basis .
3.	General	General	General	General	Back up panel for FGD in FGD control room	We understand that no separate hardwired back up panels are to be considered in FGD control room. The entire operation in FGD control room shall be through DCS/HMI. Kindly clarify.	Bidder's understanding is correct.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

4.	VI/A	III-C	16 of 18	10.01.00	Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS/ CHP DDCMIS (under Employer's scope) and FGD DDCMIS (under Contractor's scope) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be provided on as required basis, for implementation of protections and interlocks. Contractor shall provide one Remote Input Output (RIO) per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 130, DO – 130, AI – 50 and AO –50.	Kindly provide the Tentative route length distance between the following: (i) RIO Panel and employer DCS (ii) RIO Panel and 24 V DC feeder (Customer provided) (iii) FGD RIO Panel & FGD Control room for all the projects. We further understand that modification and changes required at the Customer's DCS end/station LAN for FGD interface is not in the scope of the Bidder. Kindly confirm.	It is clarified that i) RIO panel and employer's DCS are placed at the same location i.e. Central Equipment Room (CER). Tentative route length between RIO panel (Placed in CER) and employer's DCS shall be 200 meters approximately for all projects. ii) Tentative route length between RIO panel (Placed in CER) and 24 V DC feeder (NTPC scope) shall be 200 meters approximately for all projects. iii) For route length between FGD RIO panel (placed in CER) and FGD control room, bidder to refer clause 9.03.00, PART-A, Sub Section III-C, wherein it is mentioned that "Bidder to visit site to estimate the distance between FGD control room and Employer's CCR/CER". Other FGD RIO panel location shall be finalized during detailed engineering Bidder's understanding is correct that modification and changes required at the Customer's DCS end/station LAN for FGD interface is not in the scope of the bidder.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

5.	VI/B	III-C1	2 of 4	3.04.00	Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.	C&I/ Electronics is a fast moving industry. Prediction of the spares availability for lifetime of the plant is not possible during tendering stage. In this regard, NTPC may please amend the referred clause as below: <i>“Bidder shall try to ensure availability of Spares. In case of phasing out of production of spares parts, a notice of 12 months in advance regarding the same shall be provided to Owner in order to order & stock bulk requirement of spares.”</i>	With reference to clause 3.04.00, Part-B, Sub Section III-C1 of technical specification, it is clarified that lifetime of the plant is envisaged as 15 years for which bidder shall ensure supply of the spare parts. Bidder to comply with the specification.
6.	VI/B	III-C5	18 of 22	8.03.06	All the incoming / outgoing signals shall be grouped as per their origin / destination and will be terminated in the marshalling cabinets (or marshalling cum termination cabinet as the case may be).	Customer is requested to consider Cable termination at marshalling cabinet or any other equivalent methodology being followed by the manufacturer for several projects in the past. Kindly confirm.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

7.	VI/A	III-C	10 of 19	3.03.00	CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)	We understand that CEMS is already installed in the projects under Lot 2. NTPC may please review and clarify if ONE more set of CEMS is to be considered by bidder for the projects under LOT 2.	Bidder's understanding is not correct. Continuous Emission Monitoring System (CEMS) as specified under clause 3.03.00, Sub Section IIIC (C&I System), Section-VI, Part-A shall be in the scope of bidder.
8.	General	General	General	General	Flow Meters for high range flow	NTPC may please clarify if DP type of flow meters can be utilized for high flow ranges exceeding 12000 Nm ³ /Hr for Water/ slurry applications.	Bidder to note that Electromagnetic type flow meter shall be provided for these applications.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

SL NO	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
9.	VI/ A	III-C	2 of 19	1.02.01(F)	Twisted pair with round steel wired armour(SWA), Type A fieldbus cable complying to 61158(detailed specification as per PART-B), SS JB's with IP-66 and accessories for fieldbus based instruments and actuators shall be provided by the contractor under this package.	Sheet Steel JB's with IP65 protection is widely prevalent in use for Profibus. Kindly accept.	Specification requirements to be complied.
	VI/ B	III-C5	2 of 3	1.05.00	SS Junction boxes specially designed for fieldbus application shall be provided on as required basis. These SS JB's shall house field mounted fieldbus components like distributors, tee, etc. These SS JB's shall have suitable cover and gasket and shall have protection class of IP-66 or better. SS Cable glands and blind plugs shall be provided by the Contractor.	Cabinet in place of JB's can be used in places where there is wide concentration of signals. NTPC is requested to accept and mention the material and IP clause applicable for Cabinet.	

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

10.	VI/A	III-B	2 of 6	1.05.00	VFD system	Kindly specify the VFD application requirement for LOT-2 FGD packages.	Bidder to refer Cl. 1.07.00, III-B, PartA; Cl. 5.01.00 A(iv), I-M 1, PartB and Cl 15.00.00(j), I-M5, PartB for the same.
11.	General				Station LAN	We understand that only Interfacing with existing station LAN shall be in bidder's scope. Kindly confirm.	Bidder to refer clause 2.04.00, PART-A, Sub Sec IIIC wherein it is mentioned that contractor's scope shall include "A redundant station-wide LAN for connecting the unitized and common systems of FGD DDCMIS as well for connecting to Employer's Station LAN through fire-wall".

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
MECHANICAL							
12	VI/ B	I-M6	6 of 41	4.04.00	Dust extraction system Type Venturi scrubber type Location - Belt feeder after crusher -Feeder at crusher house - Limestone Storage Shed - Gypsum Shed	1. Kindly explain the working philosophy of DE system in Gypsum shed which will be open for conveyor and loader entry. 2. For Limestone silo, bag filter type DE system is to be considered.	(1) Bidder to provided DE system for Gypsum shed as per specification. Also refer amendment. (2) For Limestone silo, bag filter type DE system is acceptable.
13	VI/ A	III-A5	2 OF4	2.01.15	Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant).	In case of bucket elevator feeding to limestone bunker at FGD plant, MD shall not be applicable. In case of belt conveyor feeding to limestone bunker at FGD plant, MD shall be applicable.	Bidder's understanding is correct.
14	VI/ A	III-A5	2 OF4	2.01.16	Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing.	In case of bucket elevator feeding to limestone bunker at FGD plant, BW shall not be applicable. In case of belt conveyor feeding to limestone bunker at FGD plant, BW shall be applicable.	In case bidder offers silo storage instead of shed storage then weigh belt feeder after crusher shall be provided for feeding the bucket elevator.
15	VI/ B	I-M6	2 of 41	3.1.3.	It shall be possible to feed incoming limestone from any one conveyor to vibrating feeder & crusher of other stream.	Whether flap gate is to be provided or any other equipment is applicable. Please clarify.	Flap gate shall be provided to meet the specification requiriment.
16	VI/ B	V-QM2	4 of 9	1.08.00	Dust Control & Miscellaneous Systems (Dust Suppression & Dry Fog Dust Suppression System)	Dry Fog Dust Suppression System is not applicable. Please confirm.	Bidder's understanding is correct.
17	VI/ C	GTR	40 OF 83	28.01.00	Training for Employers O&M Personnel	Whether training is required for LHP & GHP system	Bidder to comply with technical specification.
18	VI/ C	GTR	38 OF 83	26.02.00	FGD System shall operate continuously at full load for a period not less than 72 hours.	LHP & GHP will operate intermittently based on feeding requirement	Bidder's understanding is correct.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
19	VI/ A	III-A5	2 OF 4	2.01.13	Two (2) numbers conventional enclosure type passenger cum goods elevator having capacity of 10 persons (680kg) to serve various floors of lime stone crusher house & junction tower before mill bunker building (if applicable).	In absence of junction tower between crusher house & mill bunker and provision of limestone storage silo/shed between the same whether 2 no elevator is required to be provided or not.	Specification requirement is clear.
20	-	-	-	-	-	Debris chute is not mentioned in specification. Inform if it is to be considered with specification requirement.	Debris chute to be provided for all Transfer point and crusher house.
21	VI/ B	I-M6	2 of 41 & 28 of 41	3.1.1 & limestone crusher datasheet	In limestone crusher house, limestone from each incoming Conveyor shall pass through one (1) number of (dedicated) Vibrating Feeder and one (1) number of (dedicated) crusher which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system. Through vibrating screen feeder (However the crusher shall be designed/ sized considering zero passage of limestone through screen).	Two clauses are contradicting. Please clarify whether vibrating feeder or vibrating screening feeder or vibrating grizzly feeder to be considered before crusher in crusher house.	Vibrating feeder is required. Refer amendment No.1
22	VI/ B	I-M6	28 of 41	limestone crusher datasheet	Through vibrating screen feeder (However the crusher hall be designed/ sized considering zero passage of limestone through screen).	Bidder request customer to provide seive analysis of limestone for sizing of vibrating screening feeder/ vibrating grizzly feeder.	Seive analysis of limestone is not available at this stage. Bidder to design the equipment as per the available data.
23	VI/ B	I-M6	2 of 41	3.1.3.	A passenger cum goods elevator shall be provided in limestone crusher house.	Please specify type of elevator to be considered in limestone crusher house.	Conventional type elevator shall be provided.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
24	VI/ B	I-M6	6 of 41	4.04.00	Dust extraction system Type Venturi scrubber type Location - Belt feeder after crusher -Feeder at crusher house - Limestone Storage Shed - Gypsum Shed	Bidder has considered dry type DE system in line with NTPC Lot-1A & Lot-1B FGD projects. (as per ammendments issued by NTPC for Lot-1A & 1B.) Please confirm.	Confirmed. Refer also amendment.
25	VI/ A	III-A5	2 OF 4	2.01.14	two (2) number of suspended magnets, (one no. on each conveyor feeding to Limestone bunker (in case of covered storage shed)) on conveyors.	In case of bucket elevator feeding limestone to bunker at FGD plant, Bidder will not consider any suspended magnet (SM). Please confirm.	Bidder's understanding is correct.
26	VI/ A	III-A5	2 OF 4	2.01.15	Four (4) numbers of metal detectors (min. one no. on each conveyor feed ing to crusher house and conveyor feeding to Limestone bunker at FGD plant).	Bidder will consider 02 numbers metal detectors before crusher house. But, in case of bucket elevator feeding limestone to bunker at FGD plant, Bidder will not consider any metal detectors before bunker feeding. Please confirm.	In case bidder offeres bucket elevetor for feeding to limestone bunker then metal detectors after crusher is not required.
27	VI/ A	III-A5	2 OF 4	2.01.16	Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing,	Bidder will consider 02 numbers belt weigh scales before crusher house. But, in case of bucket elevator feeding limestone to bunker at FGD plant, Bidder will not consider any belt weigh scales before bunker feeding. Please confirm.	In case bidder offers silo storage instead of shed storage then weigh belt feeder after crusher shall be provided for feeding the bucket elevator.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
28					Simhadri-I%26II (4X500 MW) II-A2-1-General Layout Plan Spat-I (3X660 MW) II-A3-1-General Layout Plan Bhilai (2X250 MW) II-A5-1-General Layout Plan Muzaffarpur II-A6-1-GLP Rourkela (1X250 MW) II-A7-1-General Layout Plan TSTPS-I%26II (6X500 MW) II-A1-1-General Layout Plan Vallur (3X500 MW) II-A4-1-General Layout Plan	Bidder request s customer to furnish autocad copy of GLP for FGD, LHP & GHP layout workout.	Bidder to develop the layout as per the pdf drawing of GLP as provided in the tender.
29	VI/ A	VII	54 of 82	O)	DUST SUPPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER	Bidder has not considered any dust supression system (dry fog dust suppression & plain water dust suppression) for limestone & gypsum handling system. Please confirm.	Dust extraction system is requiried. Refer Amendment.
30	VI/ A	VI	19 of 27	5.00.00	AUXILIARY POWER CONSUMPTION	Bidder requests customer to furnish the list of equipments to be considered for auxiliary power consumption cal. for limestone handling & gypsum handling system as the same is not given in spec.	Refer amendment.
31	VI/ A	VI	19 of 27	5.00.00	AUXILIARY POWER CONSUMPTION	Bidder requests customer to furnish the duty factor to be considered for auxiliary power consumption cal. for limestone handling & gypsum handling system as the same is not given in spec.	Refer amendment.
32	VI/ B	I-M 6	2 of 41	3.0.0	SYSTEM DESCRIPTION FDR LIM ESTONE & GYPSUM HANDLING SYSTEM	Bidder has not considered any trucks/ payloaders/ dozers for limestone & gypsum handling system. Please confirm.	Confirmed.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
CIVIL & STRUCTURAL							
33	PART-B	SUB SEC-IV-D	63 OF 64	41.00.00	Special Provisions for Simhadri and Vallur	Please confirm whether cyclonic factor k4 is applicable for Simhadri and Vallur under Wind load calculations.	Cyclonic factor k4 shall be applicable as per the provisions of IS875 Part-3 (2015)
34	PART-B	SUB SEC-IV-D	63 OF 64	41.00.00	General Provisions for all projects except Simhadri and Vallur	We understand that cyclonic factor k4 is NOT applicable for all projects under this category.	Cyclonic factor k4 shall be applicable as per the provisions of IS 875 Part-3 (2015)
35	PART-B	SUB SEC-IV-D	3 OF 64	3.01A.00	Limestone storage Silo	Please confirm whether Color coated Metal Side cladding is re-quired for Silo supporting structure or not?	Bidder to provide the same to meet any functional or technical requirement based on bidder's standard practice and experience.
36	PART-B	SUB SEC-IV-D	48 of 64	31.01.00, 31.03.00&41.00.00	All painting shall be provided with painting as given in the specification.Further painting system shall also meet the requirement of corrosivity category C3---- as per IS012944. & Painting of steel surface (other than those embedded in concrete)	We understand that bidder has to follow painting specification for steel structures as specified in clause no. 31.03.00 and same shall meets the requirements of Category requirement C3 of IS012944 . No additional requiremet to be meet.Kindly confirm. However for Simhadri and Vallur we need to folow the C5 norms kindly confirm as mentioned in clause no.41.00.00	BIDDER TO FOLLOW TECHNICAL SPECIFICATION

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
37	Sec.VI, Part-A	II-A4	2 of 37	1.04.00	Plant water details ii) Sea water quality indicated in Table-4	The analysis is for Sea water quality. Whereas the source of water is CW blow down. Kindly provide us the CW blow down water analysis.	Necessary Amendment is being issued
38	Sec.VI, Part-A	III-A4 VI VI	48 of 88 17 of 27 18 of 27	7.08.00 3-A-2, 8) XVIII, B) XVIII, C)	Design permeate water quality: Turbidity <1NTU, SDI<2 for 100% of time In functional guarantee, SWRO feed water quality is SDI limited to 3 In functional guarantee, UF permeate water quality is SDI shall be limited to 3.	The clauses are contradictory. Kindly accept SDI<=3 similar to NTEQL Vallur UF package	Necessary Amendment is being issued
39	Sec.VI, Part-A	III-A4	6 of 88 10 of 88	6.03.00 e) 6.07.00 II)	Two (2) numbers of reactor type clarifiers (both working) of RCC construction each if capacity as mentioned in ... Clarifiers 2) Number: 2 3) Design flow: 460cu.m/hr	We presume that the since both the clarifiers are working, each Clarifier capacity is 230cu.m/hr. Kindly confirm.	Bidder to comply the specification requirement .
40	Sec.VI, Part-A	III-A4	22 of 88 55 of 88 48 of 88	7.02.00 d) 7.08.00 4-G) 7.08.00 3-A-2	Two (2) numbers tube settlers/ lamella type clarifiers (both working)... 3) Design flow rate of each Clarifier: 125% of design flow of one filter feed pump (min. 1700cu.m/hr) 2)-b) UF permeate flow (net) Total design flow of all working high pressure feed pumps SWRO Unit) {not less than 1700cu.m/hr}	As per Clause 7.02.00 d), both the clarifiers are working. As per Clause 7.08.00 3 A-2, total UF permeate water requirement is minimum 1700cu.m/hr. However, as per Clause 7.08.00 4-G), each clarifier capacity is 1700cu.m/hr (125%). There is a huge difference between the actual clarified water requirement and the requirement in tender. Hence, kindly confirm whether the Clarifiers are both working (if so capacity of each clarifier) or it is only 1W+1S)	Bidder to comply the specification requirement .
41	Part-E	Drg. 0011-109(2)-POM-A-006	(Sht 5 of 7)		RO 2nd stage brine is sent to brine water storage tank.	RO 2nd stage brine TDS is in range of 2700ppm. This water can be recycled back to UF permeate tank instead of being sent to Brine water tank for disposal. Kindly confirm.	Bidder to comply the specification requirement .
42	Sec.VI, Part-A	III-A4	32 of 88	7.08.00 1-C-3) 7)	6) Maximum Pumps operating speed: 1500rpm	Kindly accept 3000rpm for RO Stage-2 HP pump which can have better efficiency.	Bidder to comply the specification requirement .
43	Vallur Sec.VI, Part-A	SUB-SECTION-III-A4	22 of 88		Terminal point for power supply to Drives in proposed RO plant (CW) in Vallur.	Kindly provide the power feeder details (number of feeders, location & rating (Volt & Amps) for the proposed plant. Kindly indicate the same in SLD. If the same is to be derived / utilised from existing LT MCC (with available spare feeders) Kindly provide the rating / Make/ Model of LT MCC. In case of New MCC for the proposed plant, Do we need to place our MCC in existing control room or separate control building to be provided. Also we exclude the following from our supply 1) Illumination in existing MCC room 2) Ventilation in existing MCC room	Bidders request shall be considered by NTPC. Use of existing feeders, if found technically feasible by employer shall be included in amendment to tender SLD.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
44	Vallur Sec.VI, Part-A	SUB- SECTION-III- A4	22 of 88		Control system	Kindly provide the details of control system for the proposed plant (PLC/ DCS). If the same is to be incorporated in the existing control system, Kindly provide the details (make/ Model) of existing PLC/ DCS. If new control system to be provided and the same to be located in existing control room, we exclude the following from our supply 1) Illumination in existing control room 2) Air conditioning in existing control room	Bidder to refer clause 2.02.01, Part-A, Sub Section IIIC wherein it is mentioned that FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems and other systems being provided under the contract, shall be implemented in the DDCMIS. Accordingly, Absorbersystem/ Limestone handling system/ Gypsum handling system/ Equipment cooling water system/ Pre treatment water system/ Desalination system and other systems being supplied under this package shall be operated, monitored and controlled form DDCMIS based control system being supplied under this package.
45	Vallur Sec.VI, Part-A	SUB- SECTION-III- A4	22 of 88		Instrument Air supply	For instrument Air & Service air Supply, we will take a tapping from existing Instrument air line. We are not considering separate compressor.	Referred query does not pertain to the referred specification clause and page no. Hence, the query is not clear.
46	Simhadri Sec.VI, Part-A	SUB- SECTION-III- A4	9 of 91		Terminal point for power supply to Drives in proposed RO plant (CW) in Vallur.	Kindly provide the power feeder details (number of feeders, location & rating (Volt & Amps) for the proposed plant. Kindly indicate the same in SLD. If the same is to be derived / utilised from existing LT MCC (with available spare feeders) Kindly provide the rating / Make/ Model of LT MCC. In case of New MCC for the proposed plant, Do we need to place our MCC in existing control room or separate control building to be provided. Also we exclude the following from our supply 1) Illumination in existing MCC room 2) Ventilation in existing MCC room	Bidders request shall be considered by NTPC. Use of existing feeders, if found technically feasible by employer shall be included in amendment to tender SLD.
47	Simhadri Sec.VI, Part-A	SUB- SECTION-III- A4	6 of 88		Control system	Kindly provide the details of control system for the proposed plant (PLC/ DCS). If the same is to be incorporated in the existing control system, Kindly provide the details (make/ Model) of existing PLC/ DCS. If new control system to be provided and the same to be located in existing control room, we exclude the following from our supply 1) Illumination in existing control room 2) Air conditioning in existing control room	Bidder to refer clause 2.02.01, Part-A, Sub Section IIIC wherein it is mentioned that FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems and other systems being provided under the contract, shall be implemented in the DDCMIS. Accordingly, Absorbersystem/ Limestone handling system/ Gypsum handling system/ Equipment cooling water system/ Pre treatment water system/ Desalination system and other systems being supplied under this package shall be operated, monitored and controlled form DDCMIS based control system being supplied under this package.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
48	Simhadri Sec.VI, Part-A	SUB- SECTION-III- A4	6 of 88		Instrument Air supply	For instrument Air & Service air Supply, we will take a tapping from existing Instrument air line. We are not considering separate compressor.	Referred query does not pertain to the referred specification clause and page no. Hence, the query is not clear.
49	SECTION-VI / Part-B	SUB- SECTION-I- M 1 (FGD)	03 of 52	1.03.08	In case of a power failure all items of equipment (eg. Minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system o Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the contractor.	Clarification: Stoppage of Process water pumps will not cause any damage to the FGD System. It is not necessary to connect process water pumps to emergency power back up.	Specification requirement shall be considered by the bidder.
50	SECTION-VI / Part-B	SUB- SECTION-I- M 1 (FGD)	14 of 52	1.03.08 5.01.00 Sl. no: iv	5.01.00 Sl. no: iv The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side.	Deviation: Normally in case of recirculation pump area, in case of any pump stoppage the gate needs to quickly close without leakages in the slurry lines. In case of knife gate valves, there may be leakages after few operations due to wearing of components. In such applications, we propose to provide pneumatic operated butterfly valves that are widely provided in FGD plants.	Specification requirement shall be considered by the bidder.
51	SECTION-VI / Part-B	SUB- SECTION-I- M 1 (FGD)	15 of 52	5.02.00	The contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (n-total no. of working agitators).	Deviation: As per our FGD design, under normal FGD operation, the jet Air Sparger (JAS) works to keep the slurry in suspension and no agitators are required to be in operation. The Agitators are required only during FGD stoppage to prevent the deposit settlement. For this purpose, we are offering two num-bers of Agitators. However, to meet tender requirement, one spare will be provided as a ware house spare.	Specification requirement shall be considered by the bidder.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
52	SECTION-VI / Part-B	SUB-SECTION-I-M 1 (FGD)	17 of 52	5.06.02	The design of flue gas ducts and inlet and outlet hoods of the FGD as well as guide vanes and baffle plates shall ensure a homogeneous flue gas flow with respect to the distributions of: (i) temperature (ii) velocity (iii) dust content (iv) slurry injection and distribution. The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct. Homogeneity shall be ensured, if the deviation from average is less than +10%. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed.	Clarification: Customer's requirement "deviation from average: less than $\pm 10\%$ " is too strict and it is not required for the stable operation at the actual plants based on MHPS' experiences. The deviation from average is generally 15-20% and MHPS designed and delivered FGD plants based on the deviation from the average for approx. $\pm 15\%$. Bidder requested to change deviation from " $\pm 10\%$ " to " $\pm 15-20\%$ ".	Specification requirement shall be considered by the bidder.
53	SECTION-VI, PART-B	SUB-SECTION-I-M 1	23 of 52	6.05.01	Wet Ball Mill vi). Limestone bond index (kWh/sh.T) : 13 (min)	Clarification: Limestone bond index shall be as : 13 (max) (kWh/sh.T)	Specification requirement shall be considered by the bidder.
54	SECTION-VI / Part-B	SUB-SECTION-I-M 1 (FGD)	33 of 52	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 300NB 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 retardant.	Clarification: As per proven practice, all the pipes irrespective of size (NB) handling slurry shall be provided with FRP material. FRP pipes are highly corrosive & abrasion resistant material and widely used for slurry application. FRP Pipes that are installed inside absorber shall be provided with Silicon carbide coating since these pipes are exposed to slurry fall during spraying. But for other areas, such silicon carbide coating is not required.	Specification requirement shall be considered by the bidder.
55	SECTION-VI / Part-B	SUB-SECTION-I-M 1 (FGD)	26 of 52	7.04.01 Sl no: c	Vacuum Belt Filters: Gypsum purity : 90 % (minimum)	Clarification: Limestone purity of 89% as CaCO ₃ is necessary to get 90% of Gypsum Purity. So Gypsum purity will be guaranteed based on 89 % of Limestone purity as CaCO ₃ .	Specification requirement shall be considered by the bidder.
56	SECTION-VI / Part-B	SUB-SECTION-I-M 1 (FGD)	30 of 52	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.	As per proven FGD practice, the installation height (shaft installation height) of the agitator will be located above the limestone/ Gypsum accumulation level of the tank. Bidder will offer agitator without emergency flushing system Please confirm	Specification requirement shall be considered by the bidder.
57	SECTION-VI / Part-A	SUB-SECTION-V Salient Design Data	01 of 21	1.00.00	SlPAT-I 3X660MW: 5. Gas flow at the FGD Inlet when firing respective coal (Nm ³ /Sec) Design Point: 838 Nm ³ / Sec (1343 m ³ /sec) Guarantee Point: 740 Nm ³ / Sec (1143 m ³ /sec)	Gas flow provided in specification for Sl-PAT 3X660MW is more than the gas flow of 800MW coal fired power plant capacity. Pl Confirm.	Gas flow is considered based on worst coal firing with appropriate leakages. Sizing of FGD system shall be carried out as per the specified parameters.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
58	Part-E (Tender Drawings), Section-VI	-	Scheme of FGD- Absorber System (DRG No: 0011- 109(2)-POM- A-001. Rev. No: A.)	Sheet 1 of 3 & Sheet 2 of 3	For Booster Fan Inlet Gate, Booster Fan Outlet Gate & FGD Bypass Damper's Seal Air System (in Sheet 1 & 2 of 3), Temperature Transmitter (TT) and Pressure Transmitter (PT) are shown in the drawing. For FGD Bypass Damper's Seal Air System (only in Sheet 1 of 3), Flow Switch (FS) & Temperature Switch (TS) is additionally shown.	Please note that all these FGD Gates & Dampers do not require any Seal Air Heaters (as per technical specification) for new wet stack arrangement. Temperature Transmitter (TT), Temperature Switch (TS) and Flow Switch (FS) are applicable only when Seal Air Heater is applicable (as in the case of FGD Outlet Gate & FGD Bypass Damper when the FGD treated Flue gas is entering the existing stack). However, for Booster Fan Inlet Gate, Booster Fan Outlet Gate & FGD Bypass Damper - for new wet stack arrangement, seal air heater is not applicable and hence, Temperature Transmitter (TT), Temperature Switch (TS) and Flow Switch (FS) are not applicable. Only Pressure Transmitter (PT) is applicable for these FGD Gates & Dampers.	Bidder's understanding is correct. Necessary Amendement is being issued

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
Compressed Air System							
107	SECTION-VI / PART-B	I-M3 COM PRESSED AIR SYSTEM	1 OF 6	2.02.00	Design and Construction – For Compressor	MOC of all components within compressor skid shall be as per OEM standard. The MOC and design of all components outside the skid shall be as per technical specification/NIT. This is being followed in all the projects executed by BIDDER for NTPC and other customers. Pl. accept.	Technical specification is in order . Bidder to comply with Technical specification requirement. However any superior MOC shall also be acceptable as per Manufacturing Standard and Proven Design.
108	SECTION-VI / PART-B	I-M3 COM PRESSED AIR SYSTEM	2 OF 6	4.00.00	Intercooler, Aftercooler & Oil coolers (For Screw)		
109	SECTION-VI / PART-B	I-M3 COM PRESSED AIR SYSTEM	5 OF 6	9.02.01	Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/modulate/energy optimization (Auto Dual Mode) in case of centrifugal	Bidder understands that Centrifugal type air compressors are not applicable for such smaller capacity machines. However, bidder request NTPC to furnish the option for reciprocating compressors, being smaller capacity compressors. Please accept.	Bidder understanding is correct that centrifugal type Air Compressor is not applicable. Tye of compressor shall be oil free screw type a sper clause 3.00.00 of Sub section IIIA -2 , section VI.
110	SECTION-VI / PART-B	I-M3 COM PRESSED AIR SYSTEM	5 OF 6	9.01.06	The following indications shall be made available in the control panels for repeating the same in main plant control system / panels.	Bidder understands that the required indications shall be made in FGD control room and not in main plant control room. Please confirm.	Bidder's understanding is correct
111	SECTION-VI / PART-A	III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COM PRESSED AIR SYSTEM	3 OF 4	3.00.00(a)	Two numbers (1 W + 1S) oil free, rotary screw type air compressors for Instrument air & service air application for.....	1.) Bidder understands that the common compressor is to be provided for Instrument air & Service application. Pl. confirm. 2.) NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate network of Instrument air & Service air to be provided. Pl. confirm.	Bidder's understanding is correct. Bidder to refer Tender drawing of Compressed air system. 00-11-109(2)-POM-A-007
112	SECTION-VI / PART-A	VI FUNCTIONAL GUARANTEES & LIQUIDITY DAM AGES	24 OF 30	xxiii	Total power consumption at motor input terminal at rated duty of air compressor.....	Bidder request NTPC to specify the duty factor for considering the auxiliary power consumption for Compressed air system. As the continuous consumption of compressed air will be much lesser than the rated compressor capacity specified by NTPC. In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements.	Duty point shall be 1.0 . Bidder to comply with specification requirement.
Chimney							
113	VI PART A	V salient design data	201 of 326	4.01.02	Single-flue chimney shall be provided. The flue gas emission point above the plant grade level shall be minimum 150 meters.	Stack height shall be arrived based on the MOEF & CC Notification dated 28.06.2018. Please accept.	The flue gas emission point above the plant grade level shall be as per the salient design data for the respective projects as indicated in the specification.
	VI PART A	V salient design data	48 of 326	24.00.01	Wet stack of 150 meter height shall be provided with a stack condensate collection system to avoid the carryover of		
Cranes & Hoist							
114	SEC VI, PART-B	I-M1	36 OF 52	14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. 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.	Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 9.09.00 of sub-section V/Section VI Part A for selection of electric or manual hoist. Kindly confirm. Further considering the layout constraints, it may not be feasible to provide hoists with trolleys for all equipment/component above 50 kg in the plant. We shall provide two nos. portable chain pulley (2T cap.) blocks to meet general handling requirements.	Bidder to comply specification requirement for the respective areas.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	SECTION – VI PART-C		5 OF 83	7.02.00	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.	Please confirm.	
	Section-VI, PART-B	I-M 6	5 OF 41	4.03.03	Hoists- Drive		
					(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings: Motor driven for both travel & lift. (ii) Other hoists including the hoists for handling take-up pulley and take-up weight: Manual for both travel & lift.		
115	SEC VI, PART- B	I-M 1	36 OF 52	14.09.00	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.	Considering the layout & space constraints, it may not be feasible to provide all electric hoists with maintenance / repair platforms with handrails. Hence maintenance platform shall be provided depending upon feasibility. Please accept.	NTPC clarified that the requirements stipulated in the specification shall be followed. Any layout specific issue shall be discussed and resolved during detailed engineering.
116	Section-VI, PART-A	Sub-Section-VII	-	-	MANDATORY SPARES:	No spares are mentioned for chain pulley blocks. Accordingly, mandatory spares shall be provided for chain pulley blocks. Please confirm.	NTPC clarified that scope as provided in the specification shall only be considered by the bidder.
117	SEC VI, PART- B	I-M5	151 OF 152	20.02.29	The control panel shall be wall mounted type and easily approachable from floor by a standing man.	The requirement is for ease of operation which is done by providing push button station at operable height. Control panels for electric hoists shall be hoist mounted. Wall mounted electric hoist will have festoon wire arrangement for power feeding which will form wire loop at one end of the travel resulting in lesser hook approach. Also, festoon wire arrangement will have roller type arrangement which requires frequent maintenance. In view of above, control panels will be hoist mounted with shrouded bus bar DSL for power feeding. This is in line with all other earlier bidder executed projects for NTPC. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/ IS3177/ IS2266 and proven practice is also acceptable .
118	SECTION – VI, PART-A	SUB-SECTION-VII	PAGE 29 OF 82	D-3) - 5)a	Electrical Items of Crane- Carbon brushes and brush holders for motors	For squirrel cage motors (preferred type for electric hoist) these items are not applicable. please confirm.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/ IS3177/ IS2266 and proven practice is also acceptable .
119	SEC VI, PART- B	SUB-SECTION-I-M 5	143 OF 152	20.01.05	Creep speed to be achieved through pony motor and planetary gear box	Creep speed shall be achieved through variable voltage variable frequency drives. (pony motor and planetary gear box is old technology) please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/ IS3177/ IS2266 and proven practice is also acceptable .
120	SEC VI, PART- B	SUB-SECTION-I-M 5	144 OF 152	20.01.10	The hoist motors shall be provided with DC electro-magnetic brakes as well as Electro Hydraulic Thrust brakes. Electro -Hydraulic Thrust brakes shall be provided for cross travel & long travel.	Please note that Electro -Hydraulic Thrust brakes are required to be supported on platform, which for single girder cranes is not feasible. Due to space constraint EHT cannot be provided. Hence, for all motions (i.e. hoisting, CT & LT) brakes provided shall be DC electromagnetic type since the same can be directly mounted on motor. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/ IS3177/ IS2266 and proven practice is also acceptable .
121	SEC VI, PART- B	SUB-SECTION-I-M 5	144 OF 152	20.01.12	A platform shall extend to full length of the crane bridge on both sides of the bridge girder.	End platform is provided for maintenance of cranes. The crane girder is single girder type and provision for full length platform cannot be provided. Accordingly, all other accessories mentioned elsewhere over crane bridge platform are also not applicable. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/ IS3177/ IS2266 and proven practice is also acceptable .

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
122	SEC VI, PART-B	SUB-SECTION-I-M5	144 OF 152	20.01.14	The main hook shall be of Ramshorn type conforming to IS: 5749	Ramshorn hook as per IS5749 is available for capacity 40T and above. For capacity less than 40T, Point hooks with Shank as per IS 15560 shall be used. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
123	SEC VI, PART-B	SUB-SECTION-I-M5	145 OF 152	20.01.15	Hoist motor shall be slip ring	For crane and hoists squirrel cage induction motors (preferred type for electric hoist) shall be used. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
	SECTION – VI PART-B	SUB-SECTION-II-E2	2 of 9	3.01.00 (c)	Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.		
124	SEC VI, PART-B	SUB-SECTION-I-M5	146 OF 152	20.01.18	DSL shall generally be on opposite side of the operator's cabin	Operator cabin is not applicable for single girder crane. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
125	SEC VI, PART-B	SUB-SECTION-I-M5	146 OF 152	20.01.21	The vertical deflection of crane girder shall not exceed 1/800 of the span	As per IS807 the vertical deflection of the crane shall be 1/750 of the span of the crane (if the span of the cranes is more than 12m), and 1/600 of the span (if the span of the crane is less than 12m). please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
126	SEC VI, PART-B	SUB-SECTION-I-M5			General-	For SG EOT Crane, square bar shall be provided as rolled section (as per IS: 3443) for low capacity cranes are not available with manufacturers i.e. SAIL, JINDAL please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
127	SEC VI, PART-B	SUB-SECTION-I-M5	148 OF 152	20.02.03	The complete hoists assembly, wire rope, hook etc. shall be ISI stamped approved	BOI shall be sourced from approved Makes/ BIS approved suppliers. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
128	SEC VI, PART-B	SUB-SECTION-I-M5	149 OF 152	20.02.15	Lifting bar of adequate design ...	Lifting bar design shall be provided and supplied by the respective equipment manufacturer that has to be lifted. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
129	SEC VI, PART-B	SUB-SECTION-I-M5	150 OF 152	20.02.25	The contractor shall terminate two feeders of 415 V AC electrical power supply near one end of the monorail beam at ground level	One no incoming supply to each electric hoist shall be provided by a suitably located feeder, to be decided during detail engineering. Hence, Two feeders are not required please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
130	SEC VI, PART-B	SUB-SECTION-I-M5			General-	Power supply for electric hoists shall be from DSL arrangement. please accept.	Technical specification requirement is clear. However, Hoists/ EOT cranes etc of proven design conforming to IS3938/IS3177/IS2266 and proven practice is also acceptable.
HVAC							
131	SECTION – VI, PART-A	SUB-SECTION-V	12 OF 21	6.02.01 a(ii)	AHU (with VVVF): 2 X 100%	VVVF are required if there are multiple areas within the air conditioned area, and there is intermittent requirement of air conditioning in these areas. However, considering the size and layout of FGD control room there shall not be any intermittent requirement of air conditioning in FGD control room. In view of the above VVVF have not been envisaged. Please confirm.	Bidder understanding is correct. Bidder to refer relevant amendment in this regard.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
132	SECTION – VI, PART-A	SUB-SECTION-V	13 OF 21	6.02.01 b	100% standby shall be provided for area served by Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners for all other control rooms covered in the scope of this package	As per the standard practice (N+1) configuration is provided for Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners, where N is number of working unit, to avoid fouling with other equipment's, facilities within the air conditioned area. NTPC is requested to accept the same.	Bidder understanding is correct . Bidder to refer relevant amendment in this regard.
ELEC							
133	PART B/ SECTION- VI	II-E1	3 of 8	2.02.00	All 11kV, 6.6kV and 3.3kV MV incomers from transformers or ties between switchgears shall be through bus ducts wherever switchgear rating is 1600Amp and above.	Because of layout constraint, we recommend connection between existing MV Switchgear & 11/6.6/ 3.3kV FGD Switchgear to be through MV Cable. Please confirm	Technical specifications are clear and Bidder to comply specification requirement.
134	PART B/ SECTION- VI	II-E4	4 of 6	2.14.04 & 3.01.00 (a)	2.14.00: All cables shall be armoured type. 3.01.00: 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outersheathed conforming to IS:7098. (Part-I).	These two clauses are in contradiction. All cables shall be unarmoured type. Cables shall be armoured type if laid in CHP area, directly buried and FGD Lime Stone and Gypsum Handling area. This is in line with NTPC LOT-1A and 1B projects. Please confirm	Bidder to follow clause no:- 2.14.00 of sub section-II/ E4 of technical specification. Also Refer amendment for the same
135	PART B/ SECTION- VI	II-E4	4 of 6	4.00.00. (c)	The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable excluding 630 sq.mm size, and 750 meter for multicore cable & single core 630 sq.mm.	Standard length for LT cables shall be 500/ 750/1000m, to avoid wastage. Please confirm	Technical specifications are clear and Bidder to comply with clause no:- 4.00.00.c of sub section-II/ E4 of technical specifications
136	PART B/ SECTION- VI	II-E5	3 of 6	2.14.02 & 3.01.00	2.14.02: All cables shall be armoured type. 3.01.00: 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLSPVC outer sheathed conforming to IS: 1554. (Part-I).	All cables shall be unarmoured type. Cables shall be armoured type if laid in CHP area, directly buried and FGD Lime Stone and Gypsum Handling area. This is in line with NTPC LOT-1A and 1B projects. Please confirm.	Bidder to follow clause no:- 2.14.02 of sub section-II/ E5 of technical specification. Also Refer amendment for the same
137	PART B/ SECTION- VI	II-E6	07, 10 of 23	3.08.01 & 4.04.04	Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, & Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre.	There is a contradiction in the specification. We are considering that the trefoils shall be clamped at every 2 meters. Please confirm.	Bidder to follow clause no:- 3.08.01 of sub section-II/ E6 of technical specification. Also Refer amendment
138	PART B/ SECTION- VI	II-E6	13 OF 23	5.01.00	Earthing System: Earthing system network/ earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant.	Ring electrode type grounding system is envisaged using mild steel rod material for limiting the ground resistance below 1 ohms, which will be connected to main plant ground grid mesh at two points. Hence, ground grid mesh for FGD area not considered. Please confirm.	Technical specifications are clear and Bidder to comply with clause no:- 5.01.00 of sub section-II/ E6 of technical specifications
139	PART B-II/ SECTION- VI	II-E7	4 of 7	2.16.04	All Cables shall be armoured type.	All HT cables shall be unarmoured type. Cables shall be armoured type if laid in CHP area, directly buried and FGD Lime Stone and Gypsum Handling area. This is in line with NTPC LOT-1A and 1B projects. Please confirm	Technical specifications are clear and Bidder to comply with clause no:- 2.16.04 of sub section-II/ E7 of technical specifications

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
140	PART B-II/ SECTION- VI	II-E7	5 OF 7	4.01.03	The standard drum length for HT power cables with a maximum tolerance of +/- 5%, may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable, and 750 meter for multicore cable.	Standard length for single core and 3 core cable HT power cable shall be 500/750m so as to avoid wastage. Please confirm.	Technical specifications are clear and Bidder to comply with clause no:- 4.01.03 of sub section-II/ E7 of technical specifications
141	PART B/ SECTION- VI	II-E15	10 OF 18	4.04.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number	The same shall be decided during detailed engineering
142	PART C/ SECTION- VI	--	75 OF 83	--	GENERAL TECHNICAL REQUIREMENTS-Public Address system	Requirement of Public Address system is not mentioned anywhere in the specification except in this clause (Applicable code and standards for Public Address System) hence Public Address System is excluded from bidder's scope of supply for FGD area. Please confirm.	Bidder's understanding is correct.
CIVIL							
143	VI/A	III-D	1 OF 3	1.05.00	Site levelling shall be done by owner as per the levels specified in GLP in tender document. However, site clearance and minor grading as required is in bidder's scope. For TSTPS there is area marked for FGD which is having slope (i.e. there is grade difference within area). Suitable modification in slope as per bidder's requirement with necessary slope protection measures shall be done by bidder.	Bidder understands that the FGL of the proposed FGD area is RL (+) 294.00 m. Please confirm. Also during detailed engineering (if necessary) only micro grading up to a maximum depth of 0.30m below FGL will be done by bidder. Please confirm.	Various finished ground level (FGLs) are there for different blocks as indicated in the GLP.
144	VI/A	III-D	1 OF 3	1.05.00	Site levelling shall be done by owner as per the levels specified in GLP in tender document. However, site clearance and minor grading as required is in bidder's scope. For TSTPS there is area marked for FGD which is having slope (i.e. there is grade difference within area). Suitable modification in slope as per bidder's requirement with necessary slope protection measures shall be done by bidder.	Since leveling and grading of proposed FGD area is in the scope of owner, bidder understands following works are in the scope of the owner: 1. Dismantling of any existing temporary/permanent structures and clearing debris. 2. Slope protection 3. Diversion of any existing facilities/structures, nalla, etc. 4. Stacked materials/equipments etc. if any, located at proposed FGD area shall be cleared by owner. Please confirm.	Blocks marked in the GLP shall be made available as per technical specification.
	VI/B	IV-D	6 OF 64	3.05.00	Control building, M. C. C. Buildings These shall be framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams.		Type of Building structure (RCC/ Steel), if not specified in the technical

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
145	VI/B	IV-D	14 OF 64	3.15.00	Limestone Grinding System Building This shall be framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams.	For the subject clauses, kindly mention whether the frame is of Structural steel or RCC. Please clarify. Further, bidder understands that for RCC framed buildings, roof/floor shall be without profile metal deck sheets, using normal removable shuttering. Please confirm.	Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any).Further, for RCC framed building's roof/floor choice of shuttering shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any)
	VI/B	IV-D	15 OF 64	3.16.00	Gypsum Dewatering Building This shall be framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams.		
146	VI/B	IV-D	15 OF 64	4.01.00	The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.	Please provide the co-ordinates and section (geometry and invert level) of owner's existing drains, where the storm water discharge from proposed FGD area shall be connected.	The details if available shall be provided at detailed engg. stage.
147	VI/B	IV-D	21 OF 64	7.00.00	The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. For floors with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet	Bidder understands that the referred clause is applicable for steel super structured buildings. Please confirm.	Minimum thickness of RCC Floor shall be 150mm for all building types.
148	VI/B	IV-D	25 OF 64	15.00.00	The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.	Please provide the co-ordinates and invert level of owner's existing sewage network, where the sewer pipe line from the proposed FGD area shall be connected.	The details if available shall be provided at detailed engg. stage.
149	VI/B	IV-D	34 OF 64	22.00.00	Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.	Bidder shall obtain approval of Civil / Architectural drawings from customer/customer's consultant before taking up the construction work. Please confirm.	BIDDER TO FOLLOW TECHNICAL SPECIFICATION
150	VI/B	IV-D	46 OF 64	30.05.00	Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.	Please provide the co-ordinates of owner's service water terminal point.	It shall be furnished during detail engineering.
151	VI/B	IV-D	46 OF 64	30.05.00	Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.	Please provide the co-ordinates of owner's potable water terminal point.	Please refer Clause 1.07.00 of Sub-Section-IV of Part-A of technical specifications for location of terminal point of potable water. Exact co-ordinate shall be provided during detail engineering.
152	VI/B	IV-D	49 OF 64	31.06.00	However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.	The clause no 9.00.00 is applicable for Earthing mat. Please clarify.	BIDDER TO refer ammendment

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
153	VI/A	II-A5	11 OF 30	7.02.03 i)	Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the employer.	Flushing of pile bore shall be done as per IS2911 Part-1 Section 2. Please confirm.	Bidder to comply the Technical Specification
154	VI/A	II-A5	13 OF 30	7.02.03 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.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Routine pile load tests to be performed on 0.5% of the total number of piles provided for each diameter/allowable capacity. 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. In case agency wish to carry out only static routine vertical load test on 0.5% of total number of piles, he may adopt the same.
155	VI/A	II-A5	16 OF 30	7.07.02.05	Recommendations on foundation system and the net allowable bearing pressure and pile capacity shall be based on the conservative values of Geotechnical investigation data.	Recommendations on foundation system and the net allowable bearing pressure and pile capacity shall be based on the average values of Geotechnical Investigation data. Please confirm.	Bidder to comply the Technical Specification
156	VI/A	II-A5	20 OF 30	ANNEXURE-III b	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.	The maximum allowable bearing pressure shall be as per the approved geotechnical report during detailed engineering. Please confirm.	Bidder is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-2.
157	VI/A	II-A5	20 OF 30	Annexure-III	Soil data and foundation system	Only Bore logs are furnished. Please furnish the following data in addition to bore logs: 1. Electrical Resistivity Test Results. 2. Laboratory test results 3. Chemical analysis of ground water and sub soil	refer ammendment
158	VI/A	II-A5	22 TO 24 OF 30	Annexure-IV	Co-ordinates of Bore Holes are given in X and Y.	Bidders understand that the Y represents to East direction and X represents the North direction. Please confirm. Also BH-31 is approx 400m away from FGD area and BH-33 is given two times, please furnish the Bore holes of FGD area.	Bidders understanding regarding co-ordinate system is correct. Further, Available Borelog have already furnished in the tender document.
159	VI/B	IV-D	9 OF 64	3.14.00	Chimney	Bidder understands that the subject Chimney will not be operated under bypass mode. Please confirm.	Please refer tender drawings in this regard.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
160	VI/B	IV-D	14 OF 64	3.14.09 (V)	The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.	Bidder understands that the entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iii) above in alternate bands of 'signal red' and 'bright white' colours. Please confirm.	BIDDER UNDERSTANDING IS CORRECT
161	VI/A	V	Page 9 of 21	4.01.04	Alternatively, Contractor can also provide chimney of 8 mm thick (minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness,.....	Please provide the detailed specification for Borosilicate Glass Block lining system, including material specification for borosilicate blocks, adhesive, erection procedure etc.	Borosilicate glass block lining shall be provided which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening as per the requirement of this clause.
162	VI/A	V	Page 9 of 21	4.01.04	Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Borosilicate Lining and insulated for Titanium/C276 cladding irrespective of surface temperature.	Bidder understands that: 1. If liner material is Titanium/C276 cladding, then there will insulation on outside surface of the liners and consequently there will be no corrosion protection paint on external surface of liners. 2. If liner material is Borosilicate lining system, then there will no insulation outside the liner and consequently there will be corrosion protection paint on external surface of liners. Please confirm.	Bidders understanding is correct.
163	VI/A	V	Page 9 of 21	4.01.05	The top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness.	1. Inside surface of chimney liner above roof shall be either clad steel (Titanium or C276) or borosilicate lining system as per specification. 2. External surface of chimney flue liner above chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation, for all the cases. Please Confirm.	NTPC clarified that the top flue liner above the roof slab shall be made of solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness in all the cases. Also, external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation, for all the cases.
164	VI/A	V	Page 9 of 21	4.01.06	External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick Titanium/C-276 sheet over insulation.		
165	VI/A	V	Page 9 of 21	4.01.05	The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner.	The maximum length projecting above the chimney roof shall be 6m as per standard practice. Please confirm.	NTPC clarified that the minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner as per requirement.
166	VI/A	III-A1	Page 9 of 9	24.00.00	Wet stack condensate collection system	Please provide the detailed material specification for condensate collection system.	NTPC clarified that the specified requirement shall be considered by the bidder.
167	VI/A	III-A1	Page 9 of 9	24.00.02	Drain piping shall be of suitable material from corrosion point of view.	Please provide the detailed material specification for condensate drain pipe.	NTPC clarified that the specified requirement shall be considered by the bidder.
168	VI/A	III-A1	Page 9 of 9	24.00.04	The design of the stack condensate collection system shall be provided by the bidder in its bid.	The design of the stack condensate collection system shall be provided during detailed engineering. Please confirm.	Specification requirement shall be considered by the bidder.

LAYOUT

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
169	Section – VI, PART -A	Sub-Section III- A1	Page 7 of 9	14.00.00	The contractor scope shall also include the provision of FGD Trestle for routing of air & water lines, slurry lines, steam line, waste water, etc. required for the complete process operations.	It is understood that pipe racks need to be constructed in new area for FGD requirement. However, existing pipe racks shall be used for routing pipes related to FGD system wherever need to do so arises. Kindly confirm.	Specification requirement shall be considered by the bidder.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
464	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION	10	5.04.00	Integration of Bus bar Protection with existing scheme	1) Kindly confirm that the existing BUSBAR Protection Numerical Relay shall have facility/provision to include additional 2no FGD bays. 2) Furnish the GA & Schematics of existing BUSBAR Protection panels.	Confirmed however bidder is requested to visit the site and collect the required details.
465	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION	10	5.04.01	Islanding Scheme	1) Trip relay for additional two no FGD bay shall be provided in FGD protection panel. No separate panel is envisaged. Kindly confirm. 2) Furnish the GA & Schematics of existing islanding panel.	Confirmed however bidder is requested to visit the site and collect the required details.
466	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION	10	5.05.00	Integration of Energy Meter with existing	We understand that standalone energy meters are envisaged. No interfacing of upcoming meters with existing meter is required. Kindly clarify.	Integration with existing ABT energy metering system is in the scope of the bidder. May refer to part-A, subsection-III B Clause no 1.06.00(f) of the technical specification.
467	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION	10	5.05.00	Dummy panels shall be supplied for mounting of owner's supplied energy meters.	Kindly confirm whether dummy panel is required for additional 2 no. transformer(FGD) bay.	Dummy panels are not required for FGD bays. Same shall be amended in the Technical specification.
468	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION	Protection SLD for 220/34.5KV FGD TIE Transformer			50LBB1, 50LBB2 Protection is shown in Protection SLD. Kindly confirm whether separate LBB protection is required or shall be use as a part of built in existing 220KV Bus Bar Protection relay.	Separate LBB Protection is required.
469	SECTION – VI, PART-B TECHNICAL SPECIFICATION BID DOC. NO. CS-0011-109(2)-2	SUB-SECTION II-E-20 CONTROL AND PROTECTION		3.00.00,4.00.00,5.00.00		Kindly furnish the existing SAS drawings like System Architecture, Networking panel drawing. Details of Gateways, Modems, Ethernet switches, Time synchroniser for each of the following projects 1) SIMHADRI 2) TALCHER 3) SPAT 4) MUZAFFARPUR 5) VALLUR 6) BHILAI 7) ROURKELA. The details are required in order to enable us to quote against the enquiry.	220kV Bay addition is applicable for Talcher Project only. SAS is not envisaged in existing system at Talcher.
470	SECTION – VI, PART-E	ELEC. SINGLE LINE DIAGRAM	61 TO 66	0011-109(2)-POE-J-001/A-F	Necessary Augmentation & Modification in existing switchgear shall be in bidder's scope.	Please confirm the OEM for existing HT switchgear for the projects covered under this tender.	Bidder is requested to visit the site and collect the required details.
	SECTION – VI, PART-B	SUB SECTION-II-E9 HT SWITCHGEAR	--	--		1) Talcher I & II 2) Simhadri I & II 3) Spat 4) Vallur 5) Bhilai 6) Rourkela 7) Muzaffarpur	

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. No.	Reference				NTPC Specification Requirement	Bidder's Query	NTPC's Clarification
	Sec/ Part	Sub-Section	Page No	Cl. No			
471	SVI (Part C)		22 of 83	13.01.00	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 be supplied by the Contractor	NTPC to clarify if the spares & topping consumables, on receipt at site will immediately be taken over and stored in their stores or the materials need to kept in our stores & handed over separately at the end of project.	NTPC clarified that the spares and topping consumables supplied as per the requirement of the specifications shall be taken over immediately.
472	SII (BDS)		20 of 28	10.1	Mandatory spares are to be supplied along with respective main equipment.		

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
483	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J-001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	Please kindly provide the following drawings for Existing 220kV AIS Switchyard of TALCHER STPP - I & II :- i) 220kV Switchyard Layout. ii) 220kV Switchyard Section. iii) 220kV Switchyard Earthmat Layout. iv) 220kV Switchyard Illumination Layout. v) 220kV Switchyard Erection Key Diagram. vi) 220kV Switchyard GA Drawing. vii) 220kV Switchyard Hydrant / Fire-fighting Layout. viii) Contour map of the switchyard area ix) Structure loading diagram for switchyard.	These drawing if required shall be provided during detailed engineering subject to availability of the same to the succesful Bidder. Further, Bidder is also requested to visit the site and collect all the required details.
484	-	-	-	TSTPS: Dwg No - 4330-999-POC-F-002, Rev-5	General Layout Plan	Please kindly demarcate existing 220kV AIS Switchyard in subject TSTPS GLP since same is not visible in GLP.	Refer amendment in GLP
485	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J-001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	Subject SLD mentions "33kV Tie Switchgear in Switchyard Area (2000A)" - please confirm where this switchgear is to be located - in existing switchyard control room building (sufficient space available ?) or by extension of existing switchyard control room building or in separate new standalone room.	33kV tie switchgear shall be housed in separate new standalone building.
486	-	-	-	TSTPS: Dwg No - 4330-999-POC-F-002, Rev-5	General Layout Plan	i) Please kindly provide plan (floorwise) & elevation of existing TSTPS switchyard control building for estimation purpose please. ii) Also please confirm number of stories of existing switchyard control building.	These drawing if required shall be provided during detailed engineering subject to availability of the same to the succesful Bidder. Further, Bidder is also requested to visit the site and collect all the required details.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
487	SECTION – VI, PART-A	III-B	2 OF 8	1.05.01	Scope of work shall also include modification as required at TSTPS Stage-I& II Switchyard control room.	i) Please kindly elaborate on scope of "modification as required" to be carried out at TSTPS Stage-I& II Switchyard control room for clarity please. ii) Please confirm whether any extension / dismantling is required to be carried out at TSTPS Stage-I& II Switchyard control room or if there is sufficient space to accommodate all ACDB, DCDB, Control & Relay panels and 33kV Switchgear in existing switchyard control building.	i) Modification in existing switchyard control room building shall be required to accommodate the system supplied by the Bidder for the Switchyard scope. Bidder to assess the same through site visit. ii) Bidder is also requested to visit the site and collect all the required details.
488	SECTION – VI, PART-A	III-B	3 OF 8	1.06.00 d)	d) Extending AC/ DC supply from owner's existing ACDB/ DCDB in switchyard area.	i) Please confirm location of existing ACDB & DCDB. ii) Please confirm if existing ACDB & DCDB have sufficient number of spare feeders in order to cater to 2 nos. 220kV AIS Switchyard extension bays in scope. iii) If not , please provide SLD of new ACDB to be provided and please confirm its power source. iv) If not , please provide SLD of new DCDB to be provided and please confirm rating of new battery to be provided (if any) for 2 nos. 220kV AIS Switchyard extension bays in scope. v) We understand that any new switchyard Auxiliary transformer is not required to be provided for subject scope of 2 nos. 220kV bay extension. Please confirm.	i) Existing ACDB and DCDB for switchyard are located in switchyard control room building. ii) Confirmed. Owner shall provide DC and AC feeders for two number 220kV bays. iii) NA iv) NA iv) Confirmed

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
489	SECTION – VI, PART-A	III-B	2 OF 8	1.05.02	Cable trenches	i) Please confirm whether cable trenches are existing in 220kV AIS switchyard and no new cable trench is required to be provided since 2 nos. 220kV AIS Bay extension appear to be located in between existing bays of 220kV AIS Switchyard as per SLD. ii) Please confirm that existing main trench to control room have sufficient space to accommodate cables for these two new bays.	Bidder to assess the adequacy of the space in existing cable trench through site visit, in case of any additional cable trench/tray is required for the laying of the cables for the Switchyard scope, same shall be in the scope of the Bidder.
490	SECTION – VI, PART-B	SUB SECTION II-E-19 SWITCHYARD ELECTRICAL	2 OF 44	1.01.08	For 220kV Switchyard, the existing Busbar is of quad/twin moose.	i) We understand that "existing busbar" in subject clause refers to 220kV existing switchyard Main Bus-I & II and Transfer bus. Please confirm. ii) We understand that only 2 nos. 220kV Jack Bus & droppers/jumpers to main/transfer bus is to be constructed - please confirm. iii) Please confirm type & runs (twin/quad) present in existing jack bus/bays.	i) Confirmed ii) & iii) This shall be as per the developed layout during detailed engineering
491	SECTION – VI, PART-B	SUB SECTION II-E-19 SWITCHYARD ELECTRICAL	2 OF 44	1.01.11	The various minimum heights of the switchyard shall be same as followed in existing switchyard.	Please kindly provide Existing 220kV Tower & Beam & equipment structure & foundation drawings of Existing 220kV AIS Switchyard of TALCHER STPP - I & II for estimation purpose please.	Bidder to collect these information through site visit., if required for estimation purpose.
492	SECTION – VI, PART-A	III-B	2 OF 8	1.05.00	SWITCHYARD	We understand that scope of switchyard extension is only applicable for Talcher STPS only and not for any other power plant in subject FGD Lot-II tender. Please confirm.	Bidder understanding is correct.
493	-	-	-	TSTPS- Dwg No - 4330-999-POC-F-002, Rev-5	General Layout Plan	Please kindly demarcate/indicate in GLP the location of 2 nos. 100MVA, 220/34.5kV FGD Tie Transformers - #1 & #2 in existing 220kV AIS switchyard since same is not visible in GLP.	Refer amendment in GLP
494	SECTION – VI, PART-B	SUB SECTION II-E-19 SWITCHYARD ELECTRICAL	2 OF 44	1.01.11	The various minimum heights of the switchyard shall be same as followed in existing switchyard.	Please kindly provide Existing 220kV Tower & Beam & equipment structure & foundation drawings of Existing 220kV AIS Switchyard of TALCHER STPP - I & II for estimation purpose please.	Bidder to collect these information through site visit., if required for estimation purpose.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
495	SECTION – VI, PART-B	SUB SECTION-II- E9 HT SWITCHGEAR	9 OF 38	4.2.00	"33kV Tie Switchgear in Switchyard Area (2000A)" - Circuit Breaker	i) Please confirm if Bidder make 33kV Switchgear having SF6 Circuit Breaker (33kV GIS) can be alternatively provided for "33kV Tie Switchgear in Switchyard Area (2000A)". Brochure of same is enclosed for kind perusal (product already successfully supplied/ under supply to several utilities including NTPC). Acceptance confirmation kindly required from NTPC in this regard. ii) If acceptable, please kindly provide suitable technical specification / amendments (& Mandatory spares list) for the same.	33kV Vacuum Circuit Breaker/ Panel to be provided as per spec requirement. Hence, Bidder to comply the technical specification in this regard.
496	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J-001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	i) We understand that number of feeders of "33kV Tie Switchgear in Switchyard Area (2000A)" indicated in subject SLD is final and no extra feeders are required. Please confirm. ii) Please kindly provide outgoing/incoming feeder ratings of "33kV Tie Switchgear in Switchyard Area " since same not available in subject SLD.	Refer ammended tender SLD for feeder details.
497	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J-001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	i) Please kindly provide size & no. of runs of 33kV cables to be provided for incoming feeders from FGD Tie transformer to 33kV Tie Switchgear and further from 33kV Tie Switchgear to 33/11.5kV FGD HT Transformer #1-#6. ii) Please kindly confirm how to lay a) 33kV cables from FGD Tie transformer to 33kV Tie Switchgear b) from 33kV Tie Switchgear to 33/11.5kV FGD HT Transformer #1-#6 - in new cable trenches or in existing cable trenches. If existing cable trenches are to be utilised, please provide route layout drawings, lengths & sections of the same.	i) Sizing shall be carried out by bidder based on design criteria specified in tender documents. ii) Bidder is requested to visit the site and collect all the required details.
498	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J-001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	It is observed that earth switches of Isolators & CT of Bus Coupler (bay #9), Spare Bays (bay#12 & bay#13) & Auto Transformer #2 bay are coloured red & legend of SLD indicates red marked scope as " Bidder's Scope". We understand that these are not in bidder's scope & tender scope is limited only to 2 nos. 220kV Bay extension (jack bus). Please confirm.	refer ammended tender SLD

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
499	PART - E TENDER DRAWINGS	SECTION – VI	63 of 66	0011-109(2)-POE-J- 001/C, Rev-B	Electrical single line diagram for FGD Package TALCHER STPP - I & II	Please kindly indicate all 220kV CT & CVT in 220kV extension bays in subject SLD for estimation purpose.	refer ammended tender SLD
500	SECTION – VI, PART-A	III-B	2 OF 8	1.05.02 II.	Material for earthing of all switchyard equipment and Gravel filling.	i) Please confirm depth of gravel filling to be provided for 2 nos. 220kV AIS Switchyard extension bays in scope. ii) We understand that any gates, fence, drains , internal switchyard service roads etc. are not required to be provided for 2 nos. 220kV AIS Switchyard extension bays in scope. Please confirm.	i) Gravel Filling shall be of two layer of 150mm (75mm layer of 20mm dia and 75mm layer of 40mm dia) ii) Bidder understanding is correct.
501	SECTION – VI, PART-A	IV TERMINAL POINTS & EXCLUSIONS	3 OF 3	1.13.01	Electrical Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in relevant clauses for SCOPE is given below : ii) Employer 220kV Bus at Switchyard (For TSTPS only)	We understand that subject clause refers to 220kV Main-1, 2 and Transfer Bus of 220kV existing AIS sub-station. Please confirm.	Bidder understanding is correct.
502	SECTION – VI, PART-A	III-B	2 OF 8	1.05.00	CONTROL & PROTECTION OF EHV SYSTEM FOR NEW BAYS	i) Please confirm that existing Bus bar protection system have sufficient capablity for extention of two bays. ii) Please specify the details/ make/ scheme of existing 220kV switchyard CRP/ SAS system.	1) Confirmed. 2) Bidder is requested to visit the site and collect the required details.
503	SECTION – VI, PART-A	III-B	2 OF 8	1.05.02 II.	Material for earthing of all switchyard equipment and Gravel filling.	Please clarify whether Main underground earthmat is already existing for two new bays or not. Please also specify grid spacing of underground earthmat in existing 220kV Switchyard.	Earthing connection to the equipment is to be extended through existing underground earth mat . Spacing of the underground earthmat is to be ascertained during enginnering by the succesful bidder through site assesment.
504	SECTION – VI, PART-A	III-B	2 OF 8	1.05.00	Study	Please confirm if insulation coordination study of LA for 220kV Switchyard is required to be conducted. Please confirm.	INSULATION CO-ORDINATION STUDY IS NOT REQUIRED HOWEVER LA AS INDICATED IN THE SLD ARE TO BE PROVIDED BY THE BIDDER.
505	SECTION – VI, PART-A	III-B	2 OF 8	1.05.00	Switchyard Civil Works	Please confirm whether any cutting or filling work and vegetation removal work is to be executed or not in 2 nos. 220kV bay extension area. We understand it is already at FGL only. Please confirm.	Minor grading as per technical specification is in Bidder's scope.
506	SECTION – VI, PART-B	SUB SECTION II- E-19 SWITCHYARD ELECTRICAL	5 OF 44	2.00.00	Switchyard 220kV Circuit Breaker	We understand that any CSD is not required to be provided in 220kV Circuit Breakers for subject 2 nos. 220kV AIS Bay extension.	Bidder to refer the Tendre SLD for the Same.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

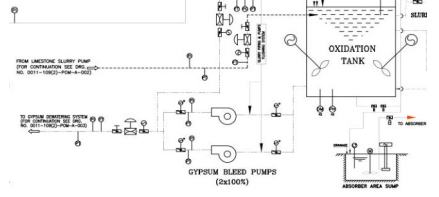
Sl. No.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
507	SECTION – VI, PART-A	III-B	2 OF 8	1.05.00	Illumination/ HVAC/ Fire-fighting	i) Please confirm whether additional illumination is to be provided in existing switchyard control room building. If required, please provide type/qty of fixtures to be provided. ii) Please confirm that any air-conditioning/ventilation/ fire-fighting is not required to be provided in existing switchyard control room building. iii) Please confirm whether hydrant or any other fire-protection system exists in 220kV switchyard bay extension area. If not, then please confirm type of fire-protection system to be provided and source of water in case of hydrant system to be provided.	I) & II) Air conditioning/ Illumination/ fire fighting is already available in the existing Switchyard control room building . However if any requirement arises due to modification under present scope , same shall be in the Bidder's scope. iii) Hydrant system in the existing Switchyard is available however same is to be extended up to the bays under the present scope by the Bidder.

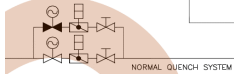
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
508	Section IV	GCC	New Definition		Common Facility for multiunit project for the purpose of Completion of Facility	For the purpose of Completion of Facility please define the the components which are part of Common Facility and need to be completion with Unit-1.	All components of common facilities need to completed with Unit-1 for the purpose of Completion of Facility.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
509	VI/B	SUB-SECTION-I-M1 (FGD)	29 of 52	7.07.06	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	Bidder shall envisage 3 mm thick Flake glass (Vinyle ester based) lining for Waste Water tank as per Clause no. 10.01.00 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD): "Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank; Vinyl Ester based flake glass lining of minimum 3 mm thickness"	NTPC clarified that requirement of the specification shall be considered by the bidder.
510	VI/A	SUB-SECTION-III-A1 FGD	6 of 9	7.08.00	All the storage tanks shall be lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness from inside.	Bidder shall envisage water tank linings as per Specification Clause no. 13.03.07 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD).	NTPC clarified that requirement of the specification shall be considered by the bidder.
511	VI/B	SUB-SECTION-I-M1 (FGD)	30 of 52	7.08.06	Suction screens shall be installed to protect the pump.	Suction screens are not applicable for auxiliary absorbent pump. Bidder shall provide Suction screens only inside the Absorber vessel to protect the Slurry recirculation pumps as per specification clause no. 5.06.23 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD).	NTPC clarified that requirement of the specification shall be considered by the bidder.
512	VI/B	SUB-SECTION-I-M1 FGD	7.07.07 & 7.07.10	29 of 52	The complete waste water neutralization.....automated and controlled from the control room. - Adequate storage and feeding system.....contractor scope - Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level... - Automated lime feeding & dosing system for Neutralization....	Employer is requested to furnish the following: 1) A detailed scheme for automated waste water neutralization system along with automated lime feeding and dosing system since same has not been shown in the Tender Drawing no. 0011-109(2)-POM-A-003, Rev-A, Scheme of Gypsum Dewatering System. 2) Please let us know the bulk density of Hydrated lime and weather this lime (supplied by Employer) will be in the form of bags or transported through trucks. 3) As Employer is arranging the Hydrated lime unto lime storage building this point needs to be incorporated in the Terminal Point Chapter (Section-VI, Part-A, Sub-section IV, Terminal Points & Exclusions). 4) Bidder understands that the lime will be manually feed to the Bucket elevator from the lime storage room.	NTPC clarified that lime shall not be hydrated. It shall be supplied in the form of bags by the employer.
	VI/A	SUB-SECTION-III-A1 FGD	2.06.00	2 of 9			
513	VI/B	SUB-SECTION-I-M1 (FGD)	8.07.00	31 of 52	For Absorber Recirculation service a Silicon Carbide impeller and SiC lining for casing can also be accepted if manufacturer has supplied a similar pump for a previous installation for similar service.	Bidder also proposes the Absorber recirculation pump impeller with Hi-chrome/ Duplex Stainless steel material and SiC lining for casing as per manufacturer's proven practice in similar applications.	NTPC clarified that the requirement specified in the specification to be considered by the bidder.
514	VI/A	SUB-SECTION-VII MANDATORY SPARES	1.07.00	7 of 82	Gear box: 1 no. for each type and size of pump	Same may not be applicable for pumps which are V-belt driven, hence bidder shall not envisage any spares for these items for V-belt driven pumps.	NTPC clarified that applicability of the spares shall be established during detailed engineering.
515	VI/C	PART - C GENERAL TECHNICAL REQUIREMENTS	30.00.00	41 of 83	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) meter 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	Bidder shall follow the same noise level limit for Limestone Crushers as mentioned below: a) Ball Mill: < 90 dBA b) Crusher: < 90 dBA Employer is requested to confirm on Bidders understanding.	Bidder to comply technical specification.
516	VI/B	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	2.02.09	3 OF 16	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.	Bidder has overground pipes in RC pump suction & discharge having size higher than 800 NB and there inspection holes are not being provided. So Bidder understands that this clause may be applicable for underground pipes only. Employer to confirm on Bidders understanding.	Bidder's understanding is correct.
517	VI/B	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	2.02.11	4 OF 16	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1 : 8. Requirement shall be decided as per relevant code.	Bidder understands that this clause is not applicable for Recycle Pump suction & discharge line. Employer to confirm on Bidders understanding.	Bidder's understanding is correct.
518	VI/A		1.25.00 (O)	54 of 82	Mandatory spares for Limestone & Gypsum handling system- Dust suppression system...	As Dust suppression system is not applicable in Limestone & Gypsum handling system, this clause is not applicable	Refer amendment in this regard.

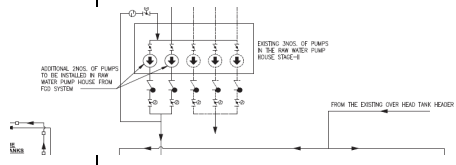
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

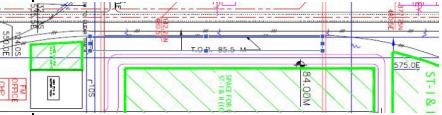
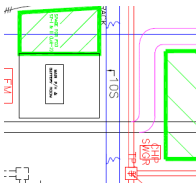
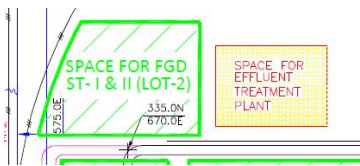
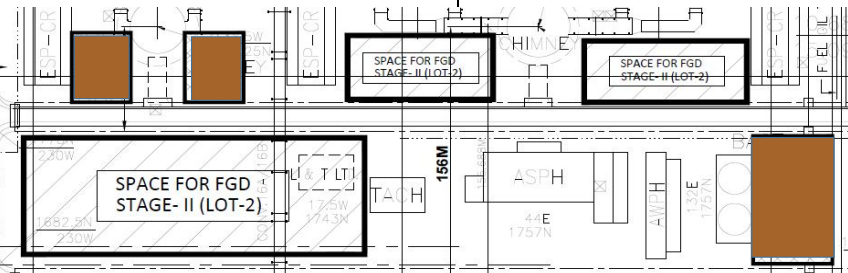
S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
519	VI/A	SUB-SECTION-III A1 FGD	5.04.00	5 of 9	The filtrate water from belt filter dewatering and wash water from washing system and the underflow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters.	-Filtrate water is not suitable for cake washing and belt cloth washing. Clarified water shall be provided for cake washing as per clause no. 7.04.07 mentioned in Technical Specification Section-VI Part B Sub section I M1 FGD & Pre NIT response to Clarification 3 (sr. no. 5) -Bidder proposes to use process water from process water pump (2x100%) for belt cloth washing, as filtrate may contain solids. Hence, separate pump (2x100%) for belt cloth washing is not envisaged.	Bidder is requested to refer Note 2 in the Gypsum Dewatering System Tender Drawing in this regard.
520	VI/B	SUB-SECTION-I M1 FGD	7.04.07	27 of 52	For cake washing only clarified water shall be used.		
521	VI/A	SUB-SECTION-VII - MANDATOR SPARES	1.17.00	10 of 82	Horizontal Centrifugal Pumps: Casing liners- 1 set of each type	Casing liner is not applicable for Water pumps. Hence bidder shall not envisage any mandatory spares for casing liners.	NTPC clarified that applicability of the spares shall be established during detailed engineering.
522	VI/B	SUB-SECTION-I M5	20.01.01	143 of 152	Electric Overhead Traveling (EOT) crane shall take care of erection/ maintenance requirement of pumps / blowers / machines and their associated auxiliaries for which these are being installed.	Bidder shall envisage Electric & Manual hoist as per clause 14.09.00, subsection I-M1, Vol. VI/B. Hence, EOT crane is not required & this is inline with Lot 1A/1B tenders.	Bidder to note that the referred CI is applicable for Vallut TPP only and where EOT crane is envisaged. Bidder to comply the specification requirement.
523	VI/A	SUB-SECTION-VII - MANDATOR SPARES	1.09.00	65 of 82	Lime Feeders	Bidder understands Lime feeder means Limestone Weigh Feeder. Employer to confirm the same.	Bidder's understanding is correct. Bidder to comply with the specification requirement.
524	VI/E	0011-109(2)-POM-A-001	1 of 3 2 of 3 3 of 3			Bidder proposes Ceramic ball control valve in place of pinch control valve in slurry line (i.e. at Gypsum Bleed to absorber, Gypsum Bleed to primary HC, Reagent slurry to Absorber inlet as shown in tender drawing no. 0011-109(2)-POM-A-001 TECHNICAL SPECIFICATION SECTION – VI, PART-E) as per bidder's proven practice. Bidder does not have any references of pinch control valves being used in mentioned service which is not at all a good design alternative A mentioned in below reasons: • The rubber of the pinch valve is likely subject to a fast abrasion during the operation as a consequence of the high velocity in the contacted section and the rubber further reduces the area of passage. To be noted that such experience is relevant to an on/off service as well, while the control valve is permanently subject to the passage of fluid which is even worse for the material. • The actuation of a pinch valve exposes the rubber of the valve to a continuous movement that can further limit the lifetime of this component during the long term operation. Further, Ceramic ball control valve is superior to Pinch control valve. Hence employer is requested to accept bidder's proposal to use Ceramic ball control valve in this regard.	NTPC clarified that requirement of the specification shall be considered by the bidder.
525	VI/A	III-A5 (Limestone & Gypsum Handling system)	2 of 4	2.01.11	Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works.	Common switch-gear rooms & MCC rooms have been considered along with other FGD facilities. Hence, separate switchgear room and MCC room have not been considered for lime-stone/gypsum handling system. Employer to confirm bidder's understanding.	Final no. of switchgear and MCC rooms shall be decided during detailed engg. based on actual layout of FGD /lime-stone/ gypsum systems.
526	VI/A	III-A5 (Limestone & Gypsum Handling system)	4 of 4	3.07.00	Complete ventilation system for gypsum storage shed.	As this gypsum shed is one side complete open, hence ventilation system is not required.	Bidder to comply technical specification.
527	VI/A	III-A5 (Limestone & Gypsum Handling system)	2 of 4	2.01.15	Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant)	Metal detector is not required between crusher house & Limestone day silo. Hence, 2 nos. metal detector will be provided before crusher house only, as limestone is stored at silo instead of limestone shed. Employer to confirm bidder's understanding.	Confirm, In case bidder proposed silo storage instead of shed storage then Metal detector after crusher is not required.
528	VI/A	III-A5 (Limestone & Gypsum Handling system)	2 of 4	2.01.16	Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing.	Belt scale is not required at limestone day silo as we are providing vibratory feeder which can be pre-set/regulated for limestone measurement. Hence, 2 nos. belt scale will be provided. Employer to confirm bidder's understanding.	In case bidder proposed silo storage instead of shed storage then weigh belt feeder after crusher shall be provided for feeding the bucket elevator.

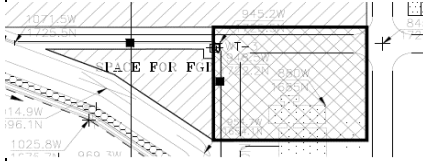
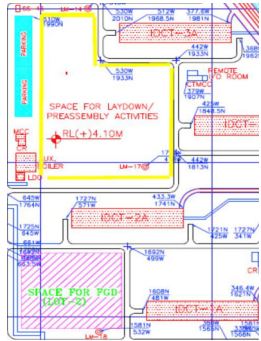
S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
529	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		1. TENDER PFD indicated gate valve and butterfly valve for water application at Process water to normal quench valve island. 2. TENDER PFD indicated gate valve and butterfly valve for water application at Process water to Emergency Water Tank valve island. 	Bidder wish to clarify that gate valve shall be provided for water application to maintain consistency all over the Tender PFD. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
530	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		TENDER PFD indicated two gate valves (closed condition) in series at process water line to Absorber for water supply into Absorber.	Bidder wish to clarify that these valves shall be replaced with pneumatically operated glove control valve to regulate level of Absorber. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
531	VI/E	DRAWING : 0011-109(2)-POM-A-002, Scheme of FGD Milling System			TENDER PFD indicated two set of valve island (one set consist of one motorized gate valve+ one pneumatic butterfly valve + one manual gate valve) at water line to Limestone Slurry Storage Tank.	Bidder wish to clarify that desired slurry density is achieved in Ball mill system and reagent slurry with desired density is stored in Limestone Slurry Storage Tank. Limestone Slurry Storage Tank is use for slurry storage purpose only. Hence, water line (with valve island) to Limestone Slurry Storage Tank is not envisaged. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
532	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber and DRAWING : 0011-109(2)-POM-A-003, Scheme of Gypsum Dewatering System			1. TENDER PFD indicated valve island (MOV+On/Off Valve+Manual Valve, all butterfly valve) in filtrate line to Absorber from Filtrate water pump. 2. TENDER PFD indicated valve island (one MOV+one On/Off Valve+Manual Valve, all butterfly valve) in filtrate line to Absorber from Filtrate water discharge pump.	Two valve island (MOV+On/Off Valve+Manual Valve, all butterfly valve) in series indicated in filtrate water line at filtrate water pump common discharge. Bidder wish to clarify that one set of valve island (MOV+On/Off Valve+Manual Valve, all butterfly valve) is sufficient for filtrate water flow to absorber from filtrate water pump common discharge. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
533	VI/E	DRAWING : 0011-109(2)-POM-A-003, Scheme of Gypsum Dewatering System			TENDER PFD indicated pneumatically operated butterfly valve at Cake wash water pump suction and discharge for water application.	Bidder wish to clarify that gate valve shall be provided for water application to maintain consistency all over the Tender PFD. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
534	VI/E	DRAWING : 0011-109(2)-POM-A-003, Scheme of Gypsum Dewatering System			TENDER PFD indicated pneumatically operated butterfly valve at Cake wash water pump suction and discharge for water application.	Bidder wish to clarify that manual gate valve shall be provided at cake wash water pump suction for water application to maintain consistency all over the TENDER PFD. Employer to confirm on Bidders understanding.	NTPC clarified that requirement of the specification shall be considered by the bidder.
535	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		Scheme shows FI (Flow Indicator) and FT (Flow Transmitter) are installed in Booster Fan common discharge flue gas duct.	We understands that Flow Indicator (FI) is a digital display of electronic Flow Transmitter (FT). No separate Flow Indicator (FI) shall be envisaged in addition of Flow Transmitter (FT). Employer to confirm on Bidders understanding.	Bidder's understanding is correct.
536	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		Schemes shows DPT with DPI across ME in Absorber.	We understands that DP Indicator (DPI) is a digital display of electronic DP Transmitter (DPT). No separate DP Indicator (DPI) shall be envisaged in addition of DP Transmitter (DPT). Employer to confirm on Bidders understanding.	Bidder's understanding is correct.
537	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		Schemes shows FT in slurry recirculation pump common discharge line.	Slurry recirculation pump discharge line size is approximately 1200 to 1400 mm. Pressure measurement at same line shall be provided instead of flow measurement. Employer to confirm on Bidders understanding.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
538	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		NOTES 5: All instruments shall be provided with isolation valves.	Bidder wish to clarify that the following cases instrument isolation valve not envisaged. 1. Ultrasonic Level Transmitter 2. Guided wave Radar Level Transmitter 3. In-line mounted instruments like Rotameter/Density Meter/Magnetic flow meter etc. 4. Any non-contact type process measurement like ultrasonic principle type measurement 5. RTD and T/C 6. Annubar type flow measurement. Employer to confirm on Bidders understanding.	Noted. However same shall be discussed and decided during detailed engineering.
539	VI/E	DRAWING : 0011-109(2)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		NOTES 10 : All slurry tanks shall be provided with field indicators for local level indication and other tanks shall be provided with level gauges for local level indication.	Bidder wish to clarify that local level gauges shall be provided for water tanks. Ultrasonic level transmitter with digital display shall be provided for slurry tank for local level indication. Hence, separate locate level gauge for slurry tank is not envisaged. Employer to confirm on Bidders understanding.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
540	VI/A	III-C (C&I SYSTEM)	16 OF 19	7.00.00	Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry , switch fuse units, MCBs, terminal blocks etc. suitable for application.	Bidder understand that "change over circuitry" shall be applicable for Main UPS only. Non-UPS power shall be evenly distributed from three phase supply bus bar. 24V DC Charger shall have redundant panel. Hence, we are not envisaged "change over circuitry" in field mounted power distribution box.	Bidder's understanding is not correct. Bidder to provide "changeover circuitry" in power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis.
541	VI/A	III-C (C&I SYSTEM)	2 OF 19	1.02.00	In this package fieldbus based controls and conventional controls (hardwired 4-20mA/DI/DO) both are envisaged.	Bidder understanding is that 1. Fieldbus (FF/Profibus) based field instrument and electrical motorized actuator shall be connected to DCS control system with fieldbus protocol. 2. Solenoid Operated Valve, Online Analyzers, CEMS, VMS and SWGR shall be connected to DCS control system with hardwired (4-20mA /DI /DO). Employer to confirm on Bidders understanding.	Bidders understanding is correct. As per specification all field transmitters (PT/DPT/TT) and motorized actuators shall be fieldbus (FF/Profibus) based and specification requirements are to be complied.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
542	VI/A	III-C (C&I SYSTEM)	2 OF 19	1.02.01	Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be discussed and finalized during detailed engineering.	Bidder understand that all field transmitters (PT/DPT/TT) and motorized actuators shall be fieldbus (FF/Profibus-PA) based instruments. CEMS, Analyzer, Solenoid Operated Valves, others transmitter, SWGR and VMS shall be hardwired based equipments. Employer to confirm on Bidders understanding.	Bidders understanding is correct. As per specification all field transmitters (PT/DPT/TT) and motorized actuators shall be fieldbus (FF/Profibus) based and specification requirements are to be complied.
543	VI/A	III-C (C&I SYSTEM)	9 OF 19	3.01.01 (b)	All Instruments which are Integral to equipment like pumps, motors etc. /skid mounted instruments and are not indicated in enclosed drawings (as applicable)...	Bidder understand that all skid mounted instruments supplied by mechanical package supplier (like Booster Fan, Ball Mill, Vacuum Belt Filter, Recycle Pump and Oxidation Blower etc. shall be hardwired (4-20mA/DI/DO). Employer to confirm on Bidders understanding.	As per the referred clause 3.01.01 b), for skid mounted instruments "Specification / type of instruments shall be as per standard and proven practice of equipment supplier". Bidder to comply with the specification requirement.
544	VI/A	III-C (C&I SYSTEM)	15 OF 19	5.01.00 (b)	All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition.	Bidder understand that power cable from UPS-ACDB/CHARGER-DCDB/NON-UPS ACDB to field power distribution board shall be sized 3CX2.5sq.mm(copper conductor) and from power distribution board to field instruments shall be sized 3CX1.5 sq.mm (Cu conductor). Instruments power cable shall be sized 3Cx1.5 sqmm (Cu conductor) as minimum. Employer to confirm on Bidder's understanding.	Noted. However, sizing of power supply distribution cable shall be decided during detailed engineering complying with the referred specification clause 5.01.00 b).
545	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	2 of 8	1.05.01	Scope of Work shall also include modification as required at TSTPS Stage-I&II Switchyard Control Room	Bidder request to employer to provide the existing TSTPS Stage-I&II Switchyard Control Room details drawing. Bidder understood that modification shall be limited to inside the control room building (like modification of trenches, panel opening, busduct opening if any only. however any extension of existing control room building is not envisaged.	Bidder may visit site to assess the modification requirements. Further Bidder to note that the 33kV switchgear shall be placed in a separate new building to be constructed in switchyard area by Bidder.
546	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	2 of 8	1.05.01	Further the scope shall also include the cabling, lighting, lightning protection,.....	Bidder understood that proposed Transformers bays under protected through existing Direct stock lightning protection(DSLP) by Lighting mast(LM) & shield wire. Bidder understand that all necessary lighting fixtures shall be mounted on existing Tower /LM only. Hence bidder is not envisaged any addition Tower/LM.	Bidder has to furnish the DSLP calculation and establish that transformer bay along with transformer is protected from direct stroke, incase of unprotected zone, Bidder has to provide suitable provision as per the specification requirement. Further Bidder has to ensure required illumination level in the bay under Bidder's Scope.If possible at site existing structures for Lighting purpose may be utilised by the Bidder for mounting of additional Lighting fixtures as required.
547	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	2 of 8	1.05.02	220kV Equipment: Circuit Breaker, Isolator, Current transformer, Surge arresters, Bus Post Insulators etc.	Bidder understand that voltage Transformer (PTs) for transformer bays are not required.	Bidder to refer the Tender SLD for the same.
548	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	3 of 8	1.05.02	Armoured Power and control cables, cabling,....	Bidder understand that indicated power cables are excluding 33kV HT cables and bidder can use 33kV HT cables are unarmoured type.	All cables shall be armoured type as per specification requirement
549	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	3 of 8	1.06.00	b) Control, Relay protection panels, Relay test kit, Relay Engineering network comprising of one OWS(operator work station), one EWS(Engineering work station), one A4 color Printer, one TSE(Time Synchronization Equipment) and networking accessories as per specification.	Bidder request to employer to furnish the following details: 1. Detail list of Relay test kit. 2. Details of existing Relay Engineering network.	Bidder is requested to kindly visit the site, get acquainted with the existing schematics and procure relevant data.
550	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	3 of 8	1.06.00	c) Integration with existing RTU/SDH, existing Bus bar protection system....	Bidder request to employer to provide the existing RTU/SDH and Busbar protection details.	Bidder is requested to visit the site and collect the required details.
551	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	4 of 8	1.06.00	f) ABT based energy meters, integration with existing metering system and,....	Bidder understood employer will provide necessary PTs connection from existing system.	Bidder's understanding is correct
552	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05	TSTPS GLP			20kV TSTPS Stage-I&II Switchyard Location	Bidder request to employer to provide the Latest layout (TSTPS GLP) with 220kV TSTPS Stage-I&II Switchyard (in present GLP we found only 400kV Switchyard)	Refer Amended GLP.
553	SLD ((0011-109(2))-POE-J-001/C Rev B	Talcher SLD			100 M VA, 220/34.5kV, FGD TIE Transformer & 2000A 33kV TIE Switchgear	Bidder understood that 220/34.5kV, FGD TIE Transformers & 33kV TIE Switchgears rating are indicative only. Actual rating shall be based on actual requirements/ calculations.	Ratings indicated are the minimum ratings. Bidder to perform sizing/calculations and supply the higher of the calculated and minimum rating specified.
554	VI/A	SUB-SECTION-III-A1 SCOPE OF SUPPLY & GYPSUM DEWATERING SYSTEM	5 of 9	5.05.00	The gypsum slurry from each absorber shall be fed to a common primary hydrocyclone tank.....	The primary hydrocyclone feed tank may or may not be required depending on the layout and so the primary hydrocyclone tank is not envisaged for all the projects. The primary hydrocyclone feed tank is not required for Project with one Boiler unit.	NTPC clarified that requirement of the specification shall be considered by the bidder.
555	VI/B	SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS	19 OF 52	5.06.07	The absorption tank shall be provided with an overflow line complete with sealing pot.....	Seal loop shall be provided as per Bidder's proven practice	NTPC clarified that requirement of the specification shall be considered by the bidder. Any technology specific issues shall be discussed during detailed engineering.
556	VI/A	SUB SECTION – VI, FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	23 of 27	6.00.00	The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code.	The performance tests shall be carried out in accordance with ASME PTC 40 code latest edition 2017.	Bidder's understanding is correct. Amendment shall be issued.
557	VI	SUB SECTION - II-A5, PROJECT INFORMATION				Bidder request employer to provide Climatological data for following projects: 1. Simhadri 2. TSTPS	Refer amendment in this regard.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
558	VI	SUB SECTION - II-A5, PROJECT INFORMATION (TSTPS)	30 OF 34 & 31 OF 34	TABLE 4	TABLE 4 IS REFERRED FOR BOTH CW BLOWDOWN WATER ANALYSIS & CLARIFIED WATER ANALYSIS.	TABLE 4 IS REFERRED (TSTPS Project information) FOR BOTH CW BLOWDOWN WATER ANALYSIS & CLARIFIED WATER ANALYSIS. UNDER CW BLOWDOWN WATER ANALYSIS TWO DIFFERENT VALUES ARE GIVEN FOR SULFATE 124.95 & 276 mg/l. CONFIRM THE SULFATE VALUE TO BE CONSIDERED.	Sulphate content of 124.95 shall be considered.
559	VI/B	IV-D (Civil Works)	9 of 64	3.13.00	Booster Fan foundations shall RCC block foundation directly resting on virgin soil/pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.	Bidder propose to use frame type RCC foundation for Booster Fans to optimize the concrete quantity if the founding level in virgin soil is more than 3.0 m below FGL at site. All other specifications shall be followed as mentioned in this clause as they are.	Bidder to follow technical specifications
560	VI/B	IV-D (Civil Works)	32 of 64	19.00.00	All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.	Bidder requests to allow large diameter tanks, absorbers, ducts to be fabricated at factory in segments, transported and welded at site before erection or fabricated at site.	Bidder to follow technical specifications
561	VI/B	IV-D (Civil Works)	58 of 64	39.02.02	Medium and High Tensile Steel - Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalized and shall also be 100% ultrasonically tested as per ASTM -A578 level B-S2.	Bidder proposes to allow usage of E350 or higher grade of steel of quality BR (Fully killed) conforming to IS: 2062 for its nominal usage in structural steel applications.	Bidder to follow technical specifications
562	VI/A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.04.00	Process Water For process water requirement, Contractor shall take a tap off suitably from the existing blow down header available near FGD area except for coastal projects (Simhadri STPP & Vallur TPP).	Bidder request customer to specify available pressure in blow down header/TP .	Pressure available at terminal point will be furnished during detail engg.
563	VI/A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.05.00	Sea water PT & Desalination plant applicable for Vallur TPP: i) Contractor shall take a tap off suitably from the existing CW blow down header (To CMB) available near the proposed Sea water PT & Desalination plant (as indicated in GLP). ii) Contractor shall terminate the discharge of backwash, cleaning & chemical waste and PT plant sludge into the existing CW blow down header (To CMB) available at 200 meter downstream of intake point to sea water PT & Desalination plant	Bidder request customer to provide material of construction used in existing CW blow down header conveying sea water. Bidder request customer to specify available pressure at TP locations. Bidder request employer to provide the CWBD pipe routing drawing so that bidder can take tapping at suitable location for PT&SWRO plant inline with Terminal point chapter.	Material of Construction of CWBD in the mentioned project is Internally Epoxy Lined MS Pipe. Exact Routing and Available Pressure at Terminal Point will be furnished during detail engg.
564	VI/A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.08.00	Waste Water FGD waste water including that of LHP/GHP shall be sent to ash slurry sump after lime neutralization.	Bidder do not envisage any waste water in LHP/ GHP area, which require Lime neutralization. Hence, lime neutralization will be done only for FGD waste water. Employer is requested to confirm on Bidder's understanding.	It shall be discussed and resolved during detail engineering
565	VI/B	SUB-SECTION-I-M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 19 OF 151	12.03.01.07	13. Service Lime slurry/Solution/Suspensions Recommended material Galvanized Steel	Bidder understands for limestone slurry application rubber lined carbon steel material is recommended instead of Galvanized Steel.	Bidder to comply the specification requirement.
566	VI/B	SUB-SECTION-I-M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 20 OF 151	12.03.01.07	16. Chlorinated Water MSRL/CPVC above ground & HDPE pipe for below ground	Bidder wishes customer to confirm whether option for use of GRP pipes for chlorinated water is available or not for both above ground & under ground.	Bidder to comply the specification requirement.
567	VI/B	SUB-SECTION-I-M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 21 OF 152	12.03.03.01	Pipes 50 NB and smaller shall have socket welded joints for chlorine line	Bidder understands this clause is applicable for only metallic pipes. For jointing non - metallic pipes procedure to be followed as mentioned in non metallic pipe specification.	Bidder's understanding is correct.
568	VI/B	SUB-SECTION-I-M6 LIMESTONE & GYPSUM HANDLING SYSTEM	Page 6 of 41	4.05.00	Service Water Service water connections are to be provided in conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two(2) nos. on each floor of crusher house.	Bidder understands Process water is only used as service water in LHS & GHS. Bidder wishes customer to specify source of Service water used in LHS & GHS if water used is different from Process water.	Refer Terminal Points of Exclusion of Part-A, Section-VI
569	VI/E	DRAWING : 0011-109(2)-POM-A-002 (SHT 1 of2). Scheme of PT plant for Simhadri				Bidder request Employer to provide the location of tapping point from existing Over head tank header for water being used for flushing	Exact location will be finalized during detail Engineering .
570	VI/B	IV-D (Civil Works)	9 of 64	3.14.01	The center to center distance between the proposed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 meters.	Considering the space available for FGD system for Bhilai (2x 250 MW) project, Bidder request to give approval for 140 m Centre to Centre distance between proposed & existing Chimney.	Bidder to comply technical specification.
571	VI/A	III (scope of supply & services)	5 of 6	1.11.00	Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. and will be in owner's scope. However, site clearance like removal of bushes, vegetation etc. is in bidder's scope.	Tree cutting may also be required during routing of flue gas duct Duct (From tapping point to absorber inlet), pipe/ cable trestles etc.. Bidder understand that the same shall also be in Employer scope along with FGD area.	Bidder's understanding is correct.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
572	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05					Bidder request Employer to provide the following drawings (which is not available in drawing): 1. Stage I (Unit 1, 2) ID system elevation & plan drawing	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
573	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05					Based on site visit, bidder request Employer to provide additional space for FGD, between railway track & road (as marked below): 	Bidder to refer ammended GLP
574	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05					During site visit, it was observed that there are some drain trenches available inside the FGD area , which is not marked in GLP. Bidder request Employer to provide existing drain trench layout of power plant showing drain trench routing in the area provided for FGD system.	Bidder to refer ammended GLP
575	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05					During site visit, it was observed that road near main P/H & battery room is incorrectly marked in GLP. Bidder request Employer to provide the updated layout. 	Bidder to refer ammended GLP
576	NTPC, Talcher Kaniha (6 x 500 MW) GLP 4330-999-POC-F-002 Rev-05					During site visit, bidder has found that space marked for FGD facilities near Effluent treatment plant is much lesser than that shown in the GLP. Bidder request Employer to provide the markup for actual space available (dimensions) along with drain trench routing. 	Bidder to refer ammended GLP
577	NTPC, Sipat (3 x 660 MW) GLP 9518-999-POC-F-001 Rev-13					As per revised GLP, space provided by Employer for all three units FGD system is not sufficient. Based on site visit, bidder request Employer to check & provide additional space for FGD near existing BAST (2 nos. instead of 4 nos. marked in GLP) , as marked below & ID fan area of Unit 3	Bidder to refer ammended GLP

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
578	VI/A	SUB-SECTION-III-D CIVIL WORKS	Page 2 of 3	2.00.00	CONSTRUCTION FACILITIES 4.Providing all arrangements for the supply of construction water induding borewells, water tankers etc.	Based on feedback of site visit, we got the feedback that arranging construction water is cahllanging to meet the tender schedule as the complete project is on piling and have approx 30m piling for major equipments and buildings. In view of such a huge civil work and tender schedule, Bidder requests employer to provide the construction water for Vallur project either free of cost or chargeable basis with in plant premises.	BIDDER TO COMPLY WITH TECHNICAL SPECIFICATION
579	NTECL Vallur (3 x 500 MW) GLP NTECL Vallur GLP Drg No. 0260-999-POC-F-001 Rev-05					At present Space provided behind the U#2 &3 (Between 1600N - 1800 N and 800W-1200W) is within 150m radius of existing stacks. We request Employer to provide additional area as shown in below extract of GLP so that 150m radius criteria for existing and new wet stack can be fulfilled. 	Bidder to refer ammended GLP
580	NTECL Vallur (3 x 500 MW) GLP Drg No. 0260-999-POC-F-001 Rev-05					Bidder envisaged that as per layout planned for FGD facilities,the foundation for duct support may rest on the existing Chimney Foundation and accordingly employer is requested to allow Bidder for it.	Duct support foundation shall not be kept on chimney foundation
581	NTECL Vallur (3 x 500 MW) GLP Drg No. 0260-999-POC-F-001 Rev-05					Bidder envisaged that as there is no space available for providing the support structure to bypass damper which needs to be installed in existing ID fan outlet duct to Chimney. So load of bypass damper will be transferred on existing structure only and employer is requested to allow Bidder for it.	It shall be discussed and resolved during detail engineering.
582	NTECL Vallur (3 x 500 MW) GLP Drg No. 0260-999-POC-F-001 Rev-05					Bidder requests employer to interchange the "SPACE FOR LAYDOWN PREASSEMBLY ACTIVITIES" WITH SPACE FOR FGD provided in between IDCT-1A and IDCT-2A 	Bidder to accommodate the FGD facilities as shown in GLP
583	Simhadri 4 x 500 MW) GLP 3530-999-POC-F-001 Rev-05					Bidder request Employer to provide the following drawings (Which is not available in tender): 1. Stage I (Unit 1, 2) ID system elevation & plan drawing	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
584	Vol. I to V	Section III BDS	20 of 28	10.1	Note: 1)Projects where FGDs are to be installed at more than 2 units, Execution shall be taken up in parallel in blocks of 2 units, hence executing agency shall work in parallel in each block of max 2 units and accordingly the schedule shall be applicable for each block of max 2 units separately. 2) The schedule given above is for 1st Unit of each block of max 2 units and Common facilities (U#1, U#3 & U#5 -as applicable). The activities specific to subsequent Unit of each block of max 2 units (U#2, U#4 & U#6-as applicable) shall be phased at an interval of 3 months, except for engineering activities which shall be completed along with 1st Unit.	Bidder request NTPC to consider any three units out of six for 32 Month completion and balance three in another 35 Months (Not necessarily in a unit sequence) Bidder also request Employer to furnish the shutdown period requirement for Damper erection in bypass duct.	NTPC clarified that the stipulations of the bidding documents shall be followed by the bidder.
585	CIVIL POINTS						
586	SECTION – VI, PART-A	SUB-SECTION-II-A1 Civil Works	7.02.01--e)	12 of 34	Before execution of work the bidder shall ensure that there is no obstruction to underground/over ground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.	Bidder understands that overground obstruction such as existing pipes, cable racks, overground electrical lines etc shall be visualized during site visit. However to understand routing of existing underground facilities like sewer lines, pipelines etc, Bidder request owner to share construction drawings of existing	Available draing shall be provided during detail engineering. Bidder shall also ensure that there is no damage to existing facilities and nearby foundations. For underground facilities survey, Ground Penetration Radar (GPR) may be used.
587	SECTION – VI, PART-A	SUB-SECTION-II-A2 Civil Works	7.02.01--e)	9 of 29			
588	SECTION – VI, PART-A	SUB-SECTION-II-A3 Civil Works	7.02.01--e)	9 of 29			

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
589	SECTION – VI, PART-A	SUB-SECTION-II-A4 Civil Works	7.02.01--e)	11 of 37		amenities so that bidder shall plan their amenities designated for FGD accordingly.	
590	SECTION – VI, PART-B	SUB-SECTION-IV-D Civil Works	4.01.00	16 of 64	Drainage System	Bidder clarifies that Employers existing drain invert level shall be necessary to plan the RCC drain (in the scope of Bidder) on which water from the pit in FGD area shall be diverted. So Bidder request Employer furnish the above information.	The details if available shall be provided at detailed engg. stage.
591	SECTION – VI, PART-B	SUB-SECTION-IV-D Civil Works	4.01.00	16 of 64	Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.	Bidder understands that scope of design and construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards shall be in the scope of Bidder. However approval from concerned Railway Authorities shall be in the scope of Owner.	Bidder to follow technical specifications
592		SUB-SECTION-II-A2 Project Information (Simhadri-I & II 4X500 MW)			General	During Site Visit it has been observed that there is one acid sump in flue gas tapping point bay near Chimney Area Unit-1. It is understood that the tank shall be dismantled during handover before start of FGD works.	Bidder to refer Clause 1.11.00 of Sub-section-III, Part-A in this regard.
593		SUB-SECTION-II-A4 Project Information (Vallur TPP-3X500 MW)			General	During Site Visit, it has been observed that there is no space available for placement of Duct Support Foundations near Chimney area because of existing structures for Unit-1 and because of extension of Chimney Raft till edge of the road for Unit-3. Hence Bidder request either placement of Duct support Foundation on the existing raft for Unit-1 or on the existing roads for both Unit-1 & 3.	The duct foundation shall not be kept over chimney foundation.
594		SUB-SECTION-II-A4 Project Information (Vallur TPP-3X500 MW)			General	From the site visit, it is presumed that there is around 3 m of Ash filling, hence Owner to clarify whether roads, ground floor slabs, trenches, pipe pedestals, channels/drain and staircase foundation can be supported on open/shallow foundation resting on virgin soil.	BIDDER TO REFER AM MENDMENT
595	General				Underground substructures, sewer pipes, water pipes, cables etc around the FGD	Bidder request Owner to please provide the drawings for underground pipes, cables, amenities, utilities etc around the FGD area.	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
596					Sand aggregate for Construction	In case of non-availability of river sand, Bidder understands that mechanical sand/crushed sand may be allowed for concrete work.	BIDDER TO REFER AM MENDMENT
597					Topographical Survey drawing	Bidder request topographical survey drawing in AutoCAD format of all proposed FGD site.	Owner provides pdf file document/ drawing s only.
598	SECTION – VI, PART-B	SUB-SECTION-IV-D Civil Works	22.00.00	34 of 64	Bidder shall obtain approval of Civil/ Architectural drawings from concerned authorities before taking up the construction work.	Bidder understands that the scope of FGD Works is limited to taking approval from Owner for Construction. Scope of obtaining approval of Civil/ Architectural drawings from concerned authorities is in owner scope.	Bidder to follow technical specifications
599		General			Chemical parameters of Ground Water	Bidder request Owner to please furnish the Chemical properties of Ground Water found in the Soil Report.	refer amendment for available data
600	SECTION – VI, PART-A	SUB-SECTION-III-D Civil Works	2.00.00	2 of 3	Providing all arrangements for the supply of construction water including borewells, water tankers.	Bidder request owner to please provide Construction water at one point (either free or chargeable) so as to address the quality of Construction Water which may be objectionable or not adhering to quality if arranged from outside from water tankers.	Bidder to follow technical specifications
601	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-III-D CIVIL WORKS	2 of 3	2.00.00 CONSTRUCTION FACILITIES, S No 10	Providing all necessary fire-fighting devices/equipment/ fire tender etc. required during the project execution stage. He shall maintain all such equipment/ devices in proper working conditions throughout the period of work.	Bidder shall provide all fire fighting devices / Equipment during the entire Project Execution period for its scope of work. However Bidder requested Employer to provide the Fire Tender of the existing Plant during emergency if required	BIDDER TO COMPLY WITH TECHNICAL SPECIFICATION
602	TECHNICAL SPECIFICATION SECTION – VI	PART-D ERECTION CONDITIONS OF CONTRACT	11 of 53	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	Bidder request Employer to furnish the following inputs / clarifications: a) Bidder request Employer to provide construction water at free of cost b) Bidder understands that Employer shall provide limestone, lime, water, compressed air etc. for Testing and commissioning at free of cost.	Bidder shall arrange its own water as per technical specification. Limestone and lime shall be supplied by the owner. Use of compressed air for testing and commissioning is not clear as per bidder's query. Same shall be discussed during detail engineering.
603	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-III-D CIVIL WORKS	2 of 3	2.00.02 CONSTRUCTION FACILITIES	However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises	Bidder envisaged that all steel structures including Chimney flue liner, Absorber & Steel Tanks shell/ Slo fabrication shall be fabricated at site within Plant boundary designated Laydown area or near to the proposed FGD Area. Bidder request Owner to provide sufficient levelled & graded land / space for development of site fabrication facility. All field connections shall be welded or bolted connections.	For steel structures factory fabrication is envisaged as per clause no 19.00.00 of TECHNICAL SPECIFICATION SECTION – VI PART-B SUB-SECTION-IV-D CIVIL WORKS. Further, any space requirement shall be discussed after award.
604	TECHNICAL SPECIFICATION SECTION-VI, PART-A	SUB-SECTION-III-D CIVIL WORKS	1 of 3	1.05.00	Site levelling shall be done by Owner as per the levels specified in GLP in tender document.		
			2 of 3	2.00.02	However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises.	Bidder understand that Site levelling for area provided for Site office pre-assembly, storage, fabrication etc. will be done by employer. Bidder requests employer to confirm the same.	Site levelling shall be done by Owner as per the levels specified in GLP for blocks marked for FGD in tender document. Only site clearance and minor grading is in bidder's scope.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
605	SLD ((0011-109(2)-POE-J-001/C Rev B	SLD	SLD	SLD	FGD HT TRFs (33/11.5kV), 11kV TIE Switchgear in FGD area, FGD Aux TRF (11/3.45kV) and 3.3kV Switchgear.	Bidder wish to consider one common (for all 6 units) 11kV TIE Switchgear in FGD area with 3 Incomers and 2 Bus Couplers and 3 Nos. FGD HT TRFs (33/11.5kV) each transformer to cater to load on its own bus plus load on adjacent bus section. Similarly, 3 Nos FGD Aux TRF (11/3.45kV) each transformer to cater to load on its own bus plus load on adjacent bus section and one no. common 3.3kV Switchgear shall be considered.	Refer amendment in SLD
606	SLD ((0011-109(2)-POE-J-001/C Rev B	SLD	SLD	SLD	Note : 7 : Bidder shall provide 3 Nos. DC system of adequate capacity for meting DC loads in FGD area	As Bidder has planned to consider all SWGRs in one common Electrical buidling, so Bidder will consider 1 Set of DC system with adequate rating insteade of 3 Sets of DC system (which is technically not required)	Refer amendment in SLD
607	SLD ((0011-109(2)-POE-J-001/C Rev B	SLD	SLD	SLD	Note : 8 : Three no. of DG set for entire FGD plant shall be provided....	Bidder wish to clarify that, the no. of DG set may be decided by Bidder based on the requirement of emergency power of the FGD system. So Bidder request employer to give this flexibility.	Refer amendment in SLD
608	SECTION – VI, PART-B	II-E2 MOTORS	4 of 9	7.04.00	Motor rated above 1000 KW shall have insulated bearing/housing to prevent flow of shaft current	Bidder shall provide NDE side end shield insulation to prevent the flow of shaft current.	Bidders offering is in line with the specification requirement
609	SECTION – VI, PART-B	II-E2 MOTORS	4 of 9	7.09.00	11 kV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 396. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.	Bidder shall provide phase segregated type terminal box (PSTB) with a fault level of 43kA for 0.25sec.	Bidder to comply specification requirement under Cl 7.09.00, II-E2
610	SECTION - VI/A	III (scope of supply & services)	5 of 6	1.11.00	Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. and will be in owner's scope. However, site clearance like removal of bushes, vegetation etc. is in bidder's scope.	Tree cutting may also be required in the laydown /storage / preassembly area, so Bidder understand that the same shall also be in Employer scope along with FGD area.	Bidder's understanding is correct.
611	SECTION – VI, PART-A	III -A1 FGD	2 of 9	2.04.00	Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper is included in the scope of Contractor.	Bidder wish to clarify following points: - Installation of bypass damper in the existing ducting is very difficult in some of the plants based on thir site visit. - In some of the site there is no space for erection of bypass dampers. - In some plants the bypass damper support & the FGD inlet duct support (at tapping points) will come on the raft of the Stack. Bidder request employer to furnish their suggesation on the above points related to bypass damper & tapping point ducting.	NTPC clarified that requirement of the specifications shall be considered by the bidder.
612	SECTION – VI, PART-A	III -A5	2 of 4	2.01.12	Exhaust fans to be provided in all battery rooms and all toilets.	Bidder wish to clarify that there is no saperate battery room for Limestone & Gypsum handling system, however all necessary ventilation system shall be provided in the MOC room common for FGD and LHS system.	Exhaust fans for battery room (if applicable) to be provided. However, Electrical to check the requirement of battery room.
613	VI/ B	VI-D - Civil Works	32 of 64	19.00.00	Silo with hopper & Chimney flue liners can either be fabricated in segments, transported and welded at site before erection or Fabricated at site.	Bidder understand that Tanks & Absorber can also be fabricated at site. Employer is requested to confirm on Bidders understanding.	Bidder to comply the specification requirement
614	SECTION-VI, PART-A & Smhadri 4 x 500 MW) GLP 3530-999-POC-F-001 Rev-05	III -A4	6 of 88	6.03.00	WATER PRE-TREATMENT PLANT	Bidder requests employer to provide the power supply from existing Switchgear available in RAWPH for bidder supplied Raw water pumps. Bidder will laid down cable from employer switchgear to Raw water pumps	Bidders request shall be considered by NTPC. Use of existing feeders, if found technically feasible by employer shall be included in ammendment to tender SLD.
615	VI/ A	SUB-SECTION- III A4 (Equipment cooling water system)	6 of 88	6.03.00 (a)	2 X100 % Raw water pump of 550 m3/hr capacity to be installed at Raw (sweet water) water pump house of Smhadri STPP St-II (2X500MW)	As per Clause No. 6.07.00 (II), the cascade aerator, stilling chamber, inlet channels, clarifier etc shall be designed for 460 m3/hr+ 3% sludge.	Bidder to comply the specification requirement
616	VI/ A	SUB-SECTION- III A4 (Equipment cooling water system)	10 of 88	6.07.00 (II)	Clarifiers: Number: 2 Design flow : 460 m3/hr	As per clause no. 6.03.00(a), Raw water pump to be designed for 550 m3/hr capacity. Process water requirement for 4 x 500 MW units at Smhadri is around 550 m3/hr. Accordingly, aerator, stilling chamber & clarifier need to be designed for	
617	IV/ A	I	19 of 21	4.07.03	Bidder/ bidder's sub vendor shall source the Ultra Filtration system including membrane upstream to Sea Water Reverse Osmosis (SWRO) plant from such suppliers who has supplied in a single SWRO plant one (1) number of UF system as offered of capacity not less than	Please clarify if suppliers with experience in SWRO without UF can be considered if they have supplied UF system for any similar applications meeting capacity and water quality.	Specification is quite clear. Bidder to comply the specification requirement

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
618	Sec-VI, Part - A	Sub Sec - III-A1	4 of 9	4.01.04	2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / positive displacement (Helical lobe) type with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank.	Please note that multistage centrifugal air compressors and root lobe type air blowers also suitable for this type of applications. We request you to please accept the above type also in addition to the types mentioned in the referred clause.	This is not a clarification. NTPC requested the bidder to consider its requirement.
619	Part-A	Sub Sec: III-A1	6 of 9	7.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of all the units)....	We propose one (1) process water storage tank for each unit catering 15 minutes storage of one (1) unit process water requirement. Please confirm.	This is not a clarification. NTPC requested the bidder to consider its requirement.
620	Sec-VI, Part - A	Sub Sec - III-A1	6 of 9	7.01.01	2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (for example total 8 nos. of pumps for 4x500 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit.	Since various plants having various number of units, hence we propose separate tank and pumps for each unit, i.e. for each unit One (1) process water storage tank of 15 Minutes storage capacity along with Two (2) Nos Process water pump and Two (2) Nos Mist Eliminator wash water pumps located near absorber area instead of Two (2) common storage tank for all the units. In that case we have an possibility of interchangeability of pumps and spares. Kindly confirm.	This is not a clarification. NTPC requested the bidder to consider its requirement.
	Sec-VI, Part - A	Sub Sec - III-A1	6 of 9	7.02.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (for example total 8 nos. of pumps for 4x500 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit.		
621	Part-A	Sub Sec: V	1 of 21 3 of 21 5 of 21 7 of 21	1.00 2.00 3.00 4.00	Inlet NOx level	Please furnish the inlet NOx level in mg/NM ³ at 6% O ₂ dry.	FGD system shall be designed using the data given in the salient design data.
622	Part-A	Sub Sec: V	1 of 21 3 of 21 5 of 21 7 of 21	1.00 2.00 3.00 4.00	Inlet SO ₂ (mg/Nm ³ Wet)	We presume that the values indicated against this clause are at actual O ₂ . Please confirm.	FGD system shall be designed using the data given in the salient design data at given O ₂ .
623	Part-A	Sub Sec: V	1 of 21	1.00	Inlet SO ₂ (mg/Nm ³ Wet)	Please note that as per the SO ₂ (%w/v wet) against guarantee condition, the SO ₂ works out to 2344 mg/NM ³ instead of 2330 indicated. Please check and clarify which value to be considered for FGD system design.	FGD system shall be designed using the data given in the salient design data.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
624	Part-A	Sub Sec: V	3 of 21	1.00	Inlet SO ₂ (mg/Nm ³ Wet)	Please note that as per the SO ₂ (%w/v wet) against guarantee and design condition, the SO ₂ works out to 2087 and 2001 mg/NM ³ respectively instead of 2079 and 2010 indicated. Please check and clarify which value to be considered for FGD system design.	FGD system shall be designed using the data given in the salient design data.
625	Part-A	Sub Sec: V	5 of 21	1.00	Inlet SO ₂ (mg/Nm ³ Wet)	Please note that as per the SO ₂ (%w/v wet) against guarantee condition, the SO ₂ works out to 2058 mg/NM ³ instead of 2070 indicated. Please check and clarify which value to be considered for FGD system design.	FGD system shall be designed using the data given in the salient design data.
626	Part-A	Sub Sec: V	7 of 21	1.00	Inlet SO ₂ (mg/Nm ³ Wet)	Please note that as per the SO ₂ (%w/v wet) against design condition, the SO ₂ works out to 1201 mg/NM ³ instead of 1215 indicated. Please check and clarify which value to be considered for FGD system design.	FGD system shall be designed using the data given in the salient design data.
627	Part-A	Sub Sec: V	1 of 21 3 of 21 5 of 21 7 of 21	1.00 2.00 3.00 4.00	Dust (mg/Nm ³)	We presume that the values indicated against this clause are wet and at actual O ₂ . Please confirm.	FGD system shall be designed using the data given in the salient design data at given O ₂ .
628	Part-A	Sub Sec: V	1 of 21 3 of 21 5 of 21 7 of 21	1.00 2.00 3.00 4.00	SO ₃ (PPM)	We presume that the values indicated against this clause are wet and at actual O ₂ . Please confirm.	FGD system shall be designed using the data given in the salient design data at given O ₂ .
629	Part-A	Sub Sec: V	2 of 21 4 of 21 6 of 21 8 of 21	1.00 2.00 3.00 4.00	HCL (PPM wet)	We presume that the values indicated against this clause are at actual O ₂ . Please confirm.	FGD system shall be designed using the data given in the salient design data at given O ₂ .
630	Part-A	Sub Sec: V	2 of 21 4 of 21 6 of 21 8 of 21	1.00 2.00 3.00 4.00	HF (PPM wet)	We presume that the values indicated against this clause are at actual O ₂ . Please confirm.	FGD system shall be designed using the data given in the salient design data at given O ₂ .
631	Part-A	Sub Sec: V	2 of 21 4 of 21 6 of 21 8 of 21	1.00	Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)	The unit auxiliary power consumption -values indicated per unit are too optimistic. Please check and revise the values.	NTPC clarified that requirement of the specification shall be considered by the bidder.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
632	Part-A	Sub Sec: V	3 of 25	2.00	Gas flow at FGD inlet when firing respective coal in guarantee and design condition - 861 m ³ / Sec and 996 m ³ /sec	Please note that the same value of gas flow has been indicated for various projects. Site elevations of every project is different and accordingly the actual flue gas flow for each project will be different from each other. Further, considering the site elevations and pressure - 0 mmWC at terminal point the actual flue gas flow rates shall be worked out for FGD system design. Please confirm whether our understanding is correct or not.	FGD system shall be designed using the data given in the salient design data at given O2.
633	Part-A	Sub Sec: V	5 of 21	3.00	Gas flow at FGD inlet when firing respective coal in guarantee and design condition - 446 m ³ / Sec and 525 m ³ /sec	Please note that the same value of gas flow has been indicated for both Bhilai and Rourkela projects. Site elevations of these projects are different and accordingly the actual flue gas flow for each project will be different from each other. Further, considering the site elevations and pressure - 0 mmWC at terminal point the actual flue gas flow rates shall be worked out for FGD system design. Please confirm whether our understanding is correct or not.	FGD system shall be designed using the data given in the salient design data at given O2.
634	Part-A	Sub Sec: V	9 of 25	4.01.05	The top flue liner above the roof slab shall be made of solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be at least equal to diameter of flue liner	Please note that in Clause No. 4.01.06 it is specified that "External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation." but in the referred clause it is specified that the top flue liner above the roof slab shall be solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. Please clarify the discrepancy and confirm the actual requirement.	Both the stipulations of the specification shall be followed.
635	Part-A	Sub Sec: V	13 of 25	6.03.00	3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas. Combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers.	Referring to S. No. 1 of the same clause, which describes that evaporative cooling type ventilation system for MCC / Switchgear Rooms and Battery Rooms. Please clarify which areas to be provided with mechanical ventilation system with combination of supply and exhaust air fans and the areas to be provided with evaporative cooling type ventilation system.	Specification requirement is amply clear. Accordingly, Evaporative type ventilation system shall be provided for non-AC area of FGD Control room building which consists of MCC room, cable gallery, battery room etc. . All other area as per clause 2.00.00 (c) of sub sec III-A2, shall have mechanical Ventilation system as specified in technical specification.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
636	Sec-VI, Part - A	Sub Sec - VI	21 of 27	5.00.00	v) Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project	Please note that Gravimetric Feeder, Wet Ball Mill and their integral auxiliaries are designed for 110% of limestone required at design point condition. Auxiliary Power shall be demonstrated for guaranteed point condition which is much below the design condition of equipment. Since, the equipment can not be operated at guaranteed point condition, we propose to adopt suitable duty factor (guaranteed point requirement/equipment rating) for computing the aux power consumption. Please confirm.	Bidder to comply requirements of the specifications.
637	Sec-VI, Part - A	Sub Sec - VI	21 of 27	5.00.00	vii) Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project	Please note that Vacuum Belt Filter and their intergal auxiliaries are designed for 110% of gypsum slurry generated at design point condition. Auxiliary Power shall be demonstrated for guaranteed point condition which is much below the design condition of equipment. Since, the equipment can not be operated at guaranteed point condition, we propose to adopt suitable duty factor (guaranteed point requirement/equipment rating) for computing the aux power consumption. Please confirm.	Bidder to comply requirements of the specifications.
638	Sec-VI, Part - A	Sub Sec - VI	21 of 27	5.00.00	xi) Mist Eliminator Wash Water pump(s)	Please note that the Mist Eliminator Water Pumps operate intermittently and not continuously operated. Hence, we propose to adopt suitable duty factor (No. of hours running in a day/24) for computation the aux. power consumption. Please confirm.	Bidder to comply requirements of the specifications.
639	Sec-VI, Part - A	Sub Sec - VI	26 of 30	7.00.00	FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO ₂ content is as below in cleaned flue gas for the range of specified coals & loads:	This clause is applicable for FGD availability and not for design purpose. Please confirm.	NTPC clarified that the referred clause is for availability guarantee of FGD system.
640	Sec-VI, Part - A	Sub Sec - VII	5 of 82 to 82 of 82		Nos. /Sets for each project	Since the quantity of mandatory spares is specified common for all the projects. Different plants having various units i.e. One (1) unit, Two (2) units, Three (3) units and Four (4) units also. Hence Please confirm the quantity of mandatory spares quantity specified in the reference section.	NTPC clarified that the quantity of spares as specified in Clause 1.01.00 of subsection-VII of Part-A shall be supplied.
641	Sec-VI, Part - B	Sub Sec - I - M1	5 of 52	2.00.00	All welding which shall be in the contact with process fluids shall be executed under the supervision of the designer/ manufacturer.	It may please be noted that liner material manufacturers do not undertake the responsibility of supervision of application/ execution. We can follow manufacturers guide lines for application. Please confirm.	Bidder to comply requirements of the specifications.
642	Sec-VI, Part - B	Sub Sec - I - M1	6 of 52	3.02.05	Bidder to note that application of lining material in the ducts shall be carried out under the supervision of designer/ manufacturer.	Please note that liner material manufacturers do not undertake the responsibility of supervision of application/ execution. We can follow manufacturers guide lines for application. Please confirm.	Bidder to comply requirements of the specifications.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
643	Sec-VI, Part - B	Sub Sec - I - M1	8 of 52	4.01.00	Pressure drop for FGD & De-NOx systems in existing ID fan in Rourkela (1x250 MW) project has already been considered and Booster fan (along with associated gates) for this project shall be provided if the required pressure drop exceeds the specified value in following clauses. Further for Rourkela (1x250 MW) project, pressure loss of 40 mmwc through chimney and 100 mm wcl (including margin) shall be considered in both booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-NOx system. In Muzaffarpur-II (2X195 MW) project, 100 mm wcl (including margin) shall be considered in both booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-NOx system.	As per the referred clause, pressure drop of 100 MMWC (including margin) across the DE Nox system shall be only be considered for Muzaffarpur (2x195 MW) and Rourkela (1x250 MW) projects and need not be considered for other projects. Please confirm. Further, please indicate the margin component included in 100 MMWC.	NTPC clarified that the specified pressure drop for DeNOx system shall only be considered for Muzaffarpur (2x195 MW) and Rourkela (1x250 MW) projects and need not be considered for other projects. Further, margin over flow and pressure shall be as per clause 4.01.02 (iii) & (iv) respectively for booster fan sizing.
644	Sec-VI, Part - B	Sub Sec - I - M1	9 of 52	4.01.01 (V)	Pressure drop considered for FGD & De-NOx systems in existing ID fan in Rourkela (1x250 MW) - 456 mmwc	Please clarify whether the pressure drop mentioned in the referred clause include margin. If YES, please indicate the margin component.	NTPC clarified that booster fan shall be provided in Rourkela project, only if the required pressure drop as per the specified criteria in the FGD system, exceeds this specified pressure drop considered in the existing ID fan.
645	Sec-VI, Part - B	Sub Sec - I - M1	10 of 52	4.01.01 (V)	Pressure drop considered for FGD & De-NOx systems in existing ID fan in Rourkela (1x250 MW) - 550 mmwc	Please clarify whether the pressure drop mentioned in the referred clause includes margin as per Clause No. 4.01.02 (iv). If YES, please indicate the margin component.	NTPC clarified that booster fan shall be provided in Rourkela project, only if the required pressure drop as per the specified criteria in the FGD system, exceeds this specified pressure drop considered in the existing ID fan.
646	Sec-VI, Part - B	Sub Sec - I - M1	9 of 52	4.01.01 (3) (iii)	Pressure at Terminal Point before Booster Fan suction - 0 mmwc	At Clause No 4.01.02 (3) (vi), Page No 10 of 52, the pressure at Booster Fan suction has been indicated as 0 mmwc. Please clarify the discrepancy and confirm which values to be considered for Booster Fan design.	NTPC clarified that requirement of the specification shall be considered by the bidder.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
647	Sec-VI, Part - B	Sub Sec - I - M1	15 of 52	5.01.00 (A) (V)	Minimum 10% spare nozzles shall be provided at each level.	Please note that in open spray tower type system all the nozzles installed in the spray bank shall be in operation, 10% of spare nozzles for each spray level shall not be isolated providing isolation valves in side the absorber for the open spray tower type system. In case 10% nozzles isolated inside the absorber, the flue gas passes through absorber with out cleaning and SO2 levels in clean gas increases and desired SO2 removal efficiencies can not be achieved. Hence, kindly note that this clause is not applicable for open spray tower type absorbers.	Bidder to comply requirements of the specifications.
648	Sec-VI, Part - B	Sub Sec - I - M1	16 of 52	5.03.03	Oxidation nozzles / spargers shall have a minimum redundancy of 10% or as per the contractor's proven practice whichever is maximum.	Please note that we are supplying lance type oxidation air system (one (1) lance for each agitator) 10% margin on oxidation air nozzle is not applicable for our design. Hence please confirm that the margin for oxidation nozzles will be applicable as per bidder design standard.	Bidder to comply requirements of the specifications.
649	Sec-VI, Part - B	Sub Sec - I - M1	20 of 52	5.06.17	The spray headers (if provided) and air supply headers shall be made of FRP or Carbon Steel with rubber lining (minimum 10 mm natural rubber lining), corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/ FRP surface exposed to slurry).	Please note that FRP spray headers and alloy steel air supply pipes in Absorber do not require any protective linings on inner/outer surfaces. Please confirm that the same will be as per Contractor or its Collaborator design requirement.	Bidder to comply requirements of the specifications.
650	Sec-VI, Part - B	Sub Sec - I - M1	26 of 52	6.05.04	The primary hydro-cyclone shall be made up of polyurethane or urethane materials.	Please confirm that in addition to the Polyurethane or urethane material Rubber lined Hydrocyclones are also acceptable.	Bidder to comply requirements of the specifications.
651	Sec-VI, Part - B	Sub Sec - I - M1	28 of 52	7.06.03	A 10% margin shall be provided in each of the pump.	Please confirm that 10% margin shall be provided on flow for Filtrate water pump only. No margin is required on Belt/cloth wash water pump.	Bidder to comply requirements of the specifications.
652	Sec-VI, Part - B	Sub Sec - I - M1	28 of 52	7.07.04	The Secondary hydro-cyclone shall be made up of polyurethane or urethane materials.	Please confirm that in addition to the Polyurethane or urethane material Rubber lined Hydrocyclones are also acceptable.	Bidder to comply requirements of the specifications.
653	Sec-VI, Part - B	Sub Sec - I - M1	28 of 52	7.07.05	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	In the reference clause the solid concentration in the waste water is limited up to 10%. Please note that to maintain the solid concentration in waste water the quantity of waste water shall be discharged more from the FGD system, in that case the process water requirement for the FGD system will be increased. Since the process water quantity available for FGD system is also limited in the Cl. No. 7.07.00 of Section - VI, Part - A, Sub Section - I-M5, page 10 of 151. We request you kindly review the requirement.	Bidder to comply requirements of the specifications.
654	Sec-VI, Part - B	Sub Sec - I - M1	29 of 52	7.07.06	The material of Casing and impeller shall be rubber lined Cast Iron (IS210 Gr FG260). Shaft and Shaft Sieves shall be Stainless Steel-410.	Please confirm that in addition to the MOC specified in the reference clause, Hi-Chrome construction waste water pump is also acceptable.	Bidder to comply requirements of the specifications.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
655	Sec-VI, Part - B	Sub Sec - I - M1	30 of 52	8.04.00	The process water lines shall be provided with pneumatic/ motorized valves as per the proven practice of the Bidder.	In the flow diagram Dwg No. 0011-109(2)-POM-A-003, Rev.A motor operated valve are indicated in the process water line. Hence please confirm that bidder can provide either Pneumatic operated or motor operated valve in all the process water, Mist Eliminator, Clarified water (Gypsum cake wash) lines.	Bidder to comply requirements of the specifications.
656	Part-B	Sub Sec:1-M1-FGD	30 of 52	8.04.00	All the slurry pumps be provided with motorized suction and discharge valves.	Please confirm that as per the notes mentioned in Flow Diagram Dwg No. 0011-109(2)-POM-A-001, A002 and A003, bidder can provide either pneumatic operated or Motor operated valves on suction and discharge lines of slurry duty pumps (except Recirculation pump) . Please confirm.	Wherever pneumatic valve as per bidder proven practice can be provided, are clearly shown in the tender drawings.
657	Part-B	Sub Sec:1-M1-FGD	31 of 52	8.05.00	In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller.	In addition to the proposed pump, we intended to propose SS 2205 (CD4MnCuN) casing with back pullout/ end suction type in addition to radial split. Please confirm.	Bidder to comply requirements of the specifications.
658	Part-B	Sub Sec:1-M1-FGD	31 of 52	8.06.00	The Bidder can also offer an hi chrome alloy line pump if the Bidder has previous experience of the same for similar applications.	We propose slurry recirculation pumps with HI Chrome impeller and SS 2205 (CD4MnCuN) casing in addition to the materials specified in the referred clauses 8.06.00 and 8.07.00. Please confirm.	Bidder to comply requirements of the specifications.
659	Part-B	Sub Sec:1-M1-FGD	31 of 52	8.09.00	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft	Please note that the critical speed of the pump shall be atleast 20% above the operating speed. Please confirm.	Bidder to comply requirements of the specifications.
660	Part-B	Sub Sec:1-M1-FGD	34 of 52	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	Please note that in LOT-2 Projects, one project having single units, two projects with 2 units, one project with 3 units and one project with 4 units and another project with 6 units. If only two(2) process water tanks are to be provided, then the process water pumps and mist eliminator water pumps for all units shall be located near process water tanks which requires lot of space to install all the pumps. Due to the space constraints, we propose one process water tank for each unit with storage capacity of 15 minutes maximum process water requirement of one unit. 2x100% capacity Booster Pumps of adequate capacity are common for the project supplies the process water to these unitised process water tank. Please confirm.	Bidder to comply requirements of the specifications.
661	Part-B	Sub Sec:1-M1-FGD	37 of 52	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.	For pipe/ cable racks, the clear head room of minimum 8 M will be provided at road/ rail crossings and at other areas, the head room will be maintained minimum 2.5 meter above the grade level. Please confirm.	Bidder to comply requirements of the specifications.
662	Part-B	Sub Sec:1-M5	34 of 151	12.05.00	Raw Water Pump for Simhadri STPP-II (2X500MW)	Please furnish existing Raw Water Pump House GA and Sump/ Tank details.	Details will be furnished during detail engineering.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
663	Part-B	Sub Sec:1-M6	2 of 41	3.1.3	In limestone crusher house, limestone coming from each incoming Conveyor shall pass through one (1) or two (2) numbers of (dedicated) Vibrating screening Feeders and one (1) or two (2) numbers of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system.	As per Clause No. 6.05.01 (III) at Page No 23 of 52, the input limestone size for wet ball mill is mentioned as 1" (i.e 25.4 mm) which is actually (-) 20 mm as per referred clause. We propose to consider the input size (-) 20 mm from the limestone crusher outlet for wet ball mill. Please confirm.	Bidder to comply requirements of the specifications.
664	Project Information for Talcher Project	Table - 4	31 of 34		Process Water/ CW Blowdown Water Analysis	In the referred Table, two different values - 125.95 mg/l and 276 mg/l are indicated for sulphates. Please clarify the discrepancy and confirm the actual value to be considered for process design.	Sulphate value of 124.95 mg/l shall be considered.
665	Spat (3x660 MW)				General Layout Plan	We request you to kindly furnish the following GA drawings with Plan and Elevation. - Conveyor 16A/ 16B - TAC House - Ash water pump house - BAST (BA Settling and Surge Tank) - ESP Control room - Main Plant Equipment layout	Available drawing shall be provided during detail engineering
666	Rourkela (1x250 MW)				General Layout Plan	Please clarify whether bidder can use the existing pipe racks for routing of Process water, clarified water and DMC water from the terminal point to the FGD system area.	Bidder to refer clause 14.00.00 of Sub-section III-A1 of Part-A of technical specifications in this regard.
667	Bhilai (2x250 MW)				General Layout Plan	We request you to kindly furnish the following GA drawings with Plan and Elevation. - Pipe racks near chimney area to Ash Slo. - Ash Water Pump House - MCC & Control room near Ash water pump house	Required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
668	Bhilai (2x250 MW)				General Layout Plan	The space earmarked in the layout is not adequate. Please confirm that bidder can use additional area available in the layout.	Please refer latest GLP being issued as an amendment.
669	Bhilai (2x250 MW)				General Layout Plan	Please clarify whether bidder can use the existing pipe racks for routing of Process water, clarified water and DMCW water from the terminal point to the FGD system area.	Bidder to refer clause 14.00.00 of Sub-section III-A1 of Part-A of technical specifications in this regard.
670	TSTPS(4x500 MW) + 2x500 MW				General Layout Plan	Please furnish the following Stage - II (Unit # 3, 4, 5 & 6) GA drawings - ESP Control room - Various ash handling building constructed in existing chimney area - Conveyor joining at TP -15 & 16 - Conveyor between TP - 23 & 24	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
671	TSTPS (4x500 MW) + 2x500 MW				General Layout Plan	Please furnish the following Stage - I (Unit # 1 & 2) GA drawings - ESP Control room - Various ash handling building constructed in existing chimney area	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
672	TSTPS (4x500 MW) + 2x500 MW				General Layout Plan	Main plant equipment drawing for Stage - I and Stage - II	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
673	Simhadri TPS (2x500 MW+2x500 MW)				General Layout Plan	Please clarify the terminal point for process water and clarified water of FGD system for Stage - I units.	Bidder to refer the Tender Drg.No. 0011-109(2)-POM-A-005 (Sht 1 of 2) in conjunction with the Technical Specifications Section VI, Part-A Sub Section III A-4 " Equipment Cooling Water System" accordingly.
674	Simhadri TPS (2x500 MW+2x500 MW)				General Layout Plan	Please furnish the GA drawing of all the existing building constructed near existing Chimney area and pipe racks near chimney	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
675	Simhadri TPS (2x500 MW+2x500 MW)				General Layout Plan	Please furnish the main equipment plan drawing for Stage - I	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
676	Simhadri TPS (2x500 MW+2x500 MW)				General Layout Plan	Please furnish the ID System elevation and plan drawing for Stage I	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
677	Simhadri TPS (2x500 MW+2x500 MW)				General Layout Plan	Please furnish the conveyor GA drawing between TP - 20 & 21 routed between Stage - I and Stage - II. Also please furnish the Conveyor GA drawing of TP -19	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
678	Vallur (3x500 MW)				General Layout Plan	Please furnish the conveyor GA drawing between the TP - 5 & TP 6. Also please furnish the GA Drawing for ESP Control room, Pipe and Cable trestle near ESP and existing chimney.	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
679					General	We understand that the NTPC replies to Pre NIT Queries shall also be part of the Tender Documents. Please confirm.	NTPC clarified that replies to Pre NIT Queries shall not be part of the Tender Documents.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	FGD SYSTEM S						
680	VI/ B	I-M 1	7 of 52	3.03.01	Guillotine gate type damper shall be provided by the Contractor before the suction of each Booster fan.	Since the specified clauses are contradictory NTPC to clarify the requirement of Guillotine Damper at the outlet of Booster fan.	Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan as per clause 22.02.00 Subsection III A1 Part A of technical specification.
	VI/ E	Scheme of FGD Absorber System 0011-109(2)-POM-A-001			<u>Scheme of FGD Absorber System</u> Guillotine Damper at Inlet and Outlet of Booster fans		
681	VI/ B	I-M 1	8 of 52	4.01.00	In Muzaffarpur-II (2X195 MW) project, 100 mm wcl (including margin) shall be considered in both booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-NOx system.	100 mm wcl (including margin) to take care of pressure loss due to future installation of De-NOx system is considered only for Muzaffarpur for remaining 6 projects the same was not considered. NTPC to confirm.	NTPC clarified that the specified pressure drop for DeNOx system shall only be considered for Muzaffarpur (2x195 MW) and Bourkela (1x250 MW) projects and need not be considered for other projects.
682	VI/ B	I-M 1	14 of 52	5.00.00	<u>ABSORBER</u> The unit shall be provided with an independent/dedicated absorber.	Considering the capacity of the FGD units common FGD is proposed for the following projects. a. NSPCL BHILAI EXPANSION POWER PROJECT (2x250 MW) b. KBUNL MUZAFFARPUR TPS, STAGE-II (2x195 MW) NTPC to confirm.	NTPC clarified that requirement of the specification shall be considered by the bidder.
683	VI/ B	I-M 1	28 of 52	7.06.02	<u>FILTRATE SYSTEM</u> 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.	The Quality of filtrate water especially chlorides will be much higher when compared to Cooling Tower Blow down (i.e Process water) hence bidder requests NTPC to allow the usage of Process water for belt cloth washing of Vacuum Belt filter as against filtrate water as specified in the referred clauses.	Bidder is requested to refer Note 2 in the Gypsum Dewatering System Tender Drawing in this regard.
684	VI/ B	I-M2	1 of 27	3.01.00(ii)	(ii) Mechanical Ventilation (using Roof extractors/ Supply and/or Exhaust fans) shall be provided for various other areas/buildings in the scope of bidder as under: a) Grinding system building b) Gypsum dewatering building c) Recirculation pump & Oxidation blower/compressor building.	Since Recirculation pump & oxidation Blower/ Compressor building is located inside a shed, mechanical ventilation is not considered for shed as per clause no 2.00.00 specified here.	Bidder to note that if shed is in open, then no mechanical ventilation is required as per specification. However, if shed/ facility is under enclosure then mechanical ventilation shall be provided as per referred clause.
685	VI/ A	III-A2	2 of 4	2.00.00 ©	Note 3: If open shed is envisaged for any facility, then in that case no mechanical ventilation is required.		
	LAYOUT						
686	VI/ A	II-A1-1	TALCHER STPS GLP-DRG NO- 4330-999-POC-F-0002/ REV-5		Space marked for FGD in front of Unit-1&2	Out of the space marked for FGD, the space marked of Dimensions 34m x 63 m in front of Unit-1&2 is not adequate to place the FGD system and placing the FGD system at other allocated spaces will call for higher inlet duct length and thereby high power and high operating cost. Request NTPC to provide additional space in front of Unit-1&2.	Bidder to refer revised GLP.
687	VI/ A	II-A3-1	SPAT STPP GLP-DRG NO- 9518-999-POC-F-001/ REV-13		Conveyor-16A/ 16B running across the space marked for FGD	NTPC is requested to provide the detailed drawings of Conveyor 16A/ 16B to access the feasibility of locating equipments in the space marked for FGD.	Available drawing shall be provided during detail engineering
688	VI/ A	II-A4-1	NTECL PP GLP-DRG NO- 0260-999-POC-F-001/ REV-5		HT Tower cable running in between Coordinates 1102.6 W, 1737.7 N and 1071.5 W, 1725.5 N	NTPC is requested to provide the following a. Elevation of HT cables across the referred coordinates b. Safe Distance to be maintained from the cables for the proposed auxiliaries	a. Bidder is requested to visit the site and collect the required elevation details. b. Safe Distance from the cables to be maintained as per the relevant Standards/ statutory requirements.

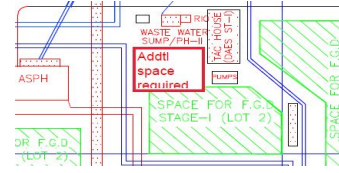
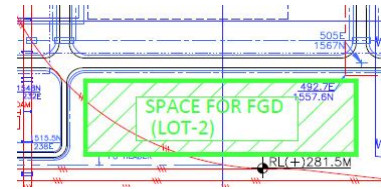
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
689	VI / A	II-A7-1	ROURKELA PP-II EXP GLP-DRG NO- PE-DG-427-100-M001		Space marked for FGD	Due to Limitation of space and capacity of the unit bidder proposes the following modification in the tender Limestone and Gypsum Handling Systems. 1. The Storage volume of both 7 day silo and one day silo works out to be 790 m3 Considering the capacity of the Lime stone storage silo, Bidder proposes 7 day silo can be at top of ball mill ,Also it serves as both 7 day storage and day storage silo.hence bidder proposes one common Limestone silo for 8 days upstream of Ball mill. In addition Bidder proposed underground crusher with a bucket elevator upstream of the above mentioned silo.,thereby avoiding lengthy conveyors and space. 2. The Gypsum Storage volume for 7 days works out to be only 1820 m3 hence bidder proposes Gypsum storage in inverted cone pyramid shape just below the vacuum belt filter which eliminates the need for travelling tripper & reduces significant space for yard occupation.	1. For Lime Stone & Gypsum Storage: Bidder's proposal for lime stone and gypsum storage is acceptable. 2. Bidder's proposal for underground crusher with bucket elevator is acceptable, however, bidder to take care of all civil, structures, archetural, mechanical & electrical requirement to meet the specification requirement at no extra cost to NTPC after award.
	ELECTRICAL						
690	VI / A	III-B	2 of 8	1.05.00	Modification required at TSTPS stage I & II switchyard control room.	NTPC to clarify / provide the list of modification in existing switchyard control room.	Bidder to assess the same through site visit. These modification shall be to accommodate the system offered by the Bidder.
691	VI / A	III-B	3 of 8	1.06.00	Control and protection of new 220KV bays and 22/34.5KV transformers	We understand that the protection relay panel shall be located in existing switchyard control room. Kindly confirm. Also NTPC to provide the existing switchyard room layout for new panel installation purpose.	Bidder's understanding is correct however bidder is requested to visit the site and obtain further details.
692	VI / A	III-B	3 of 8	1.06.00	Integration with existing RTU / SDH	Please provide the drawing for existing switchyard control schematic scheme.	Bidder is requested to visit the site and collect the required details.
693	VI / B	II-E1	1 of 8	1.06.00	The voltage level for motors shall be as follows:	For VFD application motors, we have considered the voltage rating as below - Motors below 160KW: 415 V 6 Pulse - Motors 160KW and above and upto 400KW : 690V 12 Pulse - Motors above 400KW to 700KW : 690V 12 Pulse - Motors above 700KW : 3.3KV 18 Pulse	bidder to comply with requirements of technical specification regarding design of VFD.
694	VI / B	II-E1	3 of 8	2.01.00	All transformers except 220kV class and 132kV class FDG Tie transformers are classified as Auxiliary transformers	As per project SLD, 132KV transformer is not applicable for us.	Confirmed
695	VI / B	II-E4	3 of 6	2.14.01	The voltage drop in the cables, during motor starting condition, shall be limited to 10% and during full load running condition, shallbe limited to 3% of rated voltage	We understand that the running voltage drop shall be calculated from PCC to MCC shall be 3% and MCC to motos shall be 3%. Kindly confirm.	Confirmed. However combined voltage variation at various voltage levels shall not be be more than 6% (for MV systems) and 10% (for LV systems).
696	VI / B	II-E10	1 of 57	1.01.01	For Main Plant (TG & SG areas) and Service Building, each Lighting DB shall have 1X100% transformer. For all other areas, each Lighting DB shall have 2X100% transformers	Lighting shall be provided equipments / package under FGD bidder scope only. Lighting for other area / client building are not considered.	Bidder understanding is correct
697	VI / B	II-E15	17 of 18	Annexure - B	Lighting system for TG Building Boilers Compressor area ESP Room Switchyard Area Chemical House Etc		
698	0011-109(2)-POE-J-001/A - Rev.B		Single Line diagram		Electrical Single line diagram for FGD package Simadhari Stage I & II	We understand that the tender SLD (Drg No. 0011-109(2)-POE-J-001 / A - Rev.B) is applicable common for Simahadri stage I and II (4 x 500MW). Kindly confirm.	Bidder to refer note 15 in tender SLD. SLD shows indicative supply arrangement of one stage only.
699	0011-109(2)-POE-J-001 / A/B/C/D/E/F		Single Line diagram		FGD Swrvce switchgear I with 3 nos of 11/0.433KV transformers (2working + 1 standby)	For each 1 unit or 2 unit or 3 unit configuration, we have considered the transformer for FGD package as bleow - FGD service switchgear I with 3 nos. of transformers is considered common for all absorbor LV auxiliaries power supply purose. - FGD service switchgear II with 2 nos. of transformers is considered Lime stone and Gypsum LV auxiliaries power supply purose. - FGD service switchgear III with 2 nos. of transformers is considered Cooling water, compressor, AC, Ventilation & Miscellaneous loads LV auxiliaries power supply purose.	Number of feeders / switchgeatrs shown in SLD is typical. Final feeding arrangement at various load centers shall be decided during detailed engineering based on actual loads coming in various areas.

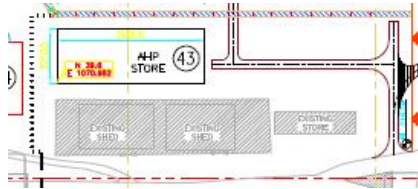
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
700	0011-109(2)-POE-J-001/C - Rev.B		Single Line diagram		22KV Switchyard	As per tender part A, section III B, cl. No. 1.05.00, page no. 2 of 8, we have considered 2 nos. of 220KV transformer bays shall be extended in existing 220KV outdoor AIS in our scope. Any Modification / new CT or earth switch fixing of existing switchyard are not considered in our scope.	Confirmed
701	4330-999-POC-F-002 / Rev.05		General Layout Plan		22KV Switchyard & new 33KV switchgear location	As per plant layout, no space available in existing switchyard area for new extension bay and 33KV switchgear building installation purpose. NTPC to indicate the area for the same in the plant tender layout.	Refer ammendment.
	CIVIL						
702	VI/A		26 to 32 of 41		Talcher Kaniha, 4x500 MW. Soil data Bore log details furnished without 'N' values.	Kindly provide detail soil invetigation report available near by areas.	Available data has already been furnished
	LHS						
703	VI/B	III-A5	2 of 4	2.01.13	Two nos. conventional type passenger cum goods elevator in lime stone crusher house and transfer tower before mill bunker.	We are considering Rack & Pinion type passenger cum goods elevators in lime stone crusher house and transfer tower before mill bunker. Please Confirm.	Bidder to comply with specification requirement.
704	VI/B	I-M6	3 of 41	3.2.0	Gypsum from storage shed shall be loaded to user's truck using front end loader / Payloader.	We understand that 1 No. front end loader / Payloader is not in Bidders scope. Please confirm.	Confirmed.
	CONTROL & INSTRUMENTATION						
705	VI/B	III-C2	23 of 40	11.00.00	Analyzers shall be placed inside Air conditioned CONTAINERISED ROOM (PORTABLE CABIN) or Air conditioned analyzer room provided by the contactor. For detailed specification of CONTAINERISED ROOM (PORTABLE CABIN), Contractor to refer Sub section IIIC-11, Part-B, Section-VI of technical specification.	Analyzers to be placed inside Air conditioned Panel placed inside Chimney shell.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
706	VI/B	III-C8	3 of 4	3.01.00	INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only.	Interface philosophy to be clarified for interface with control system thru hardwired signal or fieldbus network?	Please Refer Clause 12.00.00, Sub Section IIIC, Part-A, Section-VI, as per that Clause 3.00.00(Hardwired actuators) is not applicable for this project.
	VI/B	III-C8	3 of 4	4.01.00	INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.		

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC	PAGE NO.	CLAUSE NO.			
	LAYOUT						
707	VI/ A	II-A1-1	TALCHER STPS GLP-DRG NO- 4330-999-POC-F-0002/ REV-5		Space marked for FGD in between Unit-3 & 4 and Crushed Coal Stock pile	NTPC is requested to provide the detailed drawings of Conveyor between TP-23 and TP-24 to access the feasibility of locating equipments in the space marked for FGD.	Additional available drawings are being furnished as an Amendment. Further required drawings shall be provided during detail engineering subject to availability of the same. Bidder is requested to visit site for getting the required information in case of non-availability of the drawings.
708	VI/ A	II-A2-1	SIM HADRI TPP GLP-DRG NO- 3530-999-POC-F-0001/ REV-5		Space marked for FGD in between Unit-2 and NDCT-3	NTPC is requested to provide additional space in between space marked for FGD and Waste Water sump / ph-II as below. 	Bidder to accommodate the FGD facilities as per revised GLP.
709	VI/ A	II-A3-1	SIPAT STPP GLP-DRG NO- 9518-999-POC-F-001/ REV-13			Whether the railway track specified in the space for FGD as below is operational or redundant. 	Bidder can accommodate the FGD facilities in the space provided in the GLP.
710	VI/ A	II-A4-1	NTECL PP GLP-DRG NO- 0260-999-POC-F-001/ REV-5		Space for FGD available 	Bidder proposes Twin flue for FGD units for Boiler no-1&2 near by the space marked for FGD at Coordinates 948.5 W and 722.2 N and the distance between Existing Chimney and New Wet stack works around 140m, also beyond that space the plant boundary ends and there is no space for any further extension possible beyond that point. Hence Bidder requests NTPC to relax this clause of 150m for this plant to 140m.	Bidder to comply with the specification requirement.
	VI/ B	IV-D	9 of 64	3.14.01	The centre to centre distance between the proposed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 metres.		

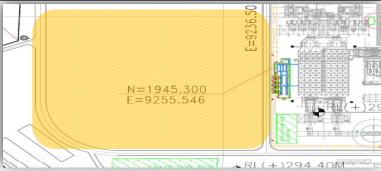
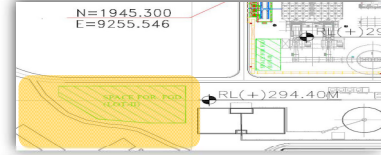
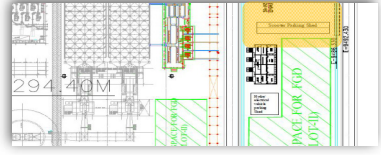
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC	PAGE NO.	CLAUSE NO.			
711	VI/ B	II-A5-1	NSPCL-2X250 M/W EPP-3 BHILLAI GLP-DRG NO- B/TS/ PLOT		Space marked for FGD	Due to Limitation of space and capacity of the unit bidder proposes the following modification in the tender Limestone and Gypsum Handling Systems. 1. The Storage volume of both 7 day silo and one day silo works out to be 1280 m³. Considering the capacity of the Lime stone storage silo, Bidder proposes 7 day silo can be at top of ball mill. Also it serves as both 7 day storage and day storage silo. hence bidder proposes one common Limestone silo for 7 days upstream of Ball mill. In addition Bidder proposed underground crusher with a bucket elevator upstream of the above mentioned silo, thereby avoiding lengthy conveyors and space. 2. The Gypsum Storage volume for 7 days works out to be only 3400 m³ hence bidder proposes Gypsum storage in inverted cone pyramid shape just below the vacuum belt filter which eliminates the need for travelling tripper & reduces significant space for yard occupation.	1. For Lime Stone & Gypsum Storage: Bidder's proposal for lime stone and gypsum storage is acceptable. 2. Bidder's proposal for underground crusher with bucket elevator is acceptable, however, bidder to take care of all civil, structures, architectural, mechanical & electrical requirement to meet the specification requirement at no extra cost to NTPC after award.
712	VI/ A	II-A7-1	ROURKELA PP-II EXP GLP-DRG NO- PE-DG-427-100-M001		Space marked for FGD	The space marked for FGD is inadequate to place the facilities required as per tender, hence bidder requests NTPC to provide the space as below (Existing Shed and Existing Store near by AHP Store-43) for FGD system so that the facilities can be accommodated. 	Bidder to refer revised GLP furnished as amendment.

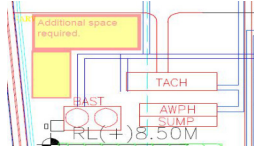
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
713	V	SOC	6 of 27	14.1	Royalty	(i) Please confirm whether any surplus excavated material/ rock/ sand/ earth within plant boundary may be utilized by the Contractor for the purpose of construction activities, free of cost (with prior consent of Employer) Any royalty payable on the same shall be reimbursed by the Employer to the Contractor. (ii) We understand that in case, it is necessary to dispose the excessive excavated material outside the plant premises, then all clearance(s)/ permissions shall be arranged by Employer and all the applicable Charges including royalty, transportation etc. shall be borne by Employer. Please confirm.	(i) Any excavated material such as rock / sand/ earth may be utilised subject to meeting the technical requirements of relevant purpose for which it is intended to be used. Further the bidder shall pay any fees, royalties etc. that have to be paid for utilisation of same. (ii) Bidder to refer clause no 25.00.00 of technical specification section -VI, Part -B sub section-IV-D Civil works regarding disposal of surplus excavated material. Further bidder is required to arrange the area outside plant boundary where backfilling material can be disposed off at his own cost. All necessary permission , applicable charges royalty etc for the same shall be borne by the bidder.

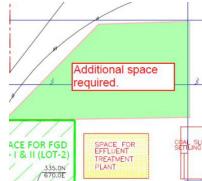
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
714	Bhilai (2X250 MW) II-A5-6- Pipe Cable Trestle Layout				Observation during site visit	As per the Drg. No. PE-DG-239-100-002 REV.1 sheet 4 of 4 - Pipe cable trestle layout section PR-13 & PR-14 - pile/cable trestle top is (+)9.55 M & (+)12.95 M., where as, during site visit the pipe / cable trestle are found to be routed at elevation of (+)2.2m (TOS) over which pipes of 400 nb(max) are routed (refer reference drg. no. PE-DG-239-100-002 REV.1 -sheet 2 of 4). Bidder presumes and considers to route the FGD duct clearing the existing the pipe routing as per the site conditions and as per drg no. PE-DG-239-100-002 REV.1 -sheet 2 of 4). Please check and confirm.	Bidder to route the FGD duct clearing the existing pipe routing as per the site conditions. Any further layout constraint shall be discussed during detail engineering.
715	Bhilai (2X250 MW): Bhilai (2X250 MW) II-A5-1- General Layout Plan.pdf	GENERAL LAYOUT PLAN DRG. NO. B/ TS PLOT, SHT 1 of 1, Rev. 0				Space provided by NTPC is not sufficient to accommodate all the FGD facilities. During site visit bidder has noticed that free space available within the co-ordinates between E 9000 & E 9200 and N 2000 & N 1800. Bidder requests NTPC to provide above additional space for Limestone handling conveyor, Crusher, Bulk & Day Silos, Mill building and slurry preparation of FGD System and equipment. Please confirm.	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
716	Bhilai (2X250 MW): Bhilai (2X250 MW) II-A5-1- General Layout Plan.pdf	GENERAL LAYOUT PLAN DRG. NO. B/ TS PLOT, SHT 1 of 1, Rev. 0				Space provided by NTPC is not sufficient to accommodate all the FGD facilities. During site visit bidder has noticed that free space available within the co-ordinates between E 9000 & E 9200 and N 1800 & N 1600. Bidder requests NTPC to re-routing of road and provide additional space beside Waste water Holding Tank as indicated.	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
717	Bhilai (2X250 MW): Bhilai (2X250 MW) II-A5-1- General Layout Plan.pdf	GENERAL LAYOUT PLAN DRG. NO. B/ TS PLOT, SHT 1 of 1, Rev. 0				Bidder requests NTPC to Shift existing Scooter parking Shed to some other place and provide space beside BM D Maintenance bay/ stores for FGD System. Bidder request NTPC to provide space between the co-ordinates E 9400 & E 9600 and N 2000 & N 1800.	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
718	Rourkela PP-II (1X250 MW): Rourkela (1X250 MW) II-A7-1- General Layout Plan.pdf	PLOT PLAN DRG. NO. PE-DG-427-100-M001, SHT 1 of 1, Rev. 09				Space provided by NTPC is not sufficient to accommodate all the FGD facilities. Bidder requests NTPC to provide additional space of 140m x 60 m required for Limestone handling conveyor, Crusher, Bulk & Day Silos, Mill building and slurry preparation of FGD System.	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
719	Spat-I (3X660 MW) II-A6-1- General Layout Plan					NTPC to provide following drawings, which are not received along with the tender document. 1. Existing coal conveyor 16A/ B 2. Existing coal conveyor 5A/ B 3. Equipment Layout Plan The above drawing were asked in earlier clarification on draft tender, which are extremely essential for planning of FGD facilities.	Available drawing shall be provided during detail engineering
720	Spat-I (3X660 MW) II-A6-1- General Layout Plan					NTPC to note that in the provided FGD space, existing railway track is passing, hence, entire space can not be utilised for FGD facilities. Bidder requests NTPC to provide additional space of Approx. 150m length x 70m wide as marked in the below snap to accommodate all the facilities. 	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
721	Simhadri-II (2X500 MW) II-A5-1- General Layout Plan					Bidder requests owner to provide following drawings 1. Stage-I, ID system elevation and plan drawing 2. Stage-I, Equipment Layout Plan of stage-I facilities 3. Stage-I, Pipe Cable Trestle Layout with foundation details 4. Existing coal conveyor 18A/ B, 19A/ B & 20A/ B (i.e. Conveyors between TP-18, TP-19, TP-20 & TP-21) 5. Existing coal conveyor 6A/ B (i.e. Conveyor between TP-4 & TP-5) 6. AHP key plan of Stage-II AHP facilities to check interference with existing AHP facilities. The above drawing were asked in earlier clarification on draft tender, which are extremely essential for planning of FGD facilities.	Requested drawings "Equipment Layout plan and Pipe cable trestle" is not available with us.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
722	Simhadri-II (2X500 MW) II-A5 1-General Layout Plan					To accommodate the FGD facilities within the available space, Bidder requests NTPC to provide yellow marked space as indicated in below snap near stage-II AHP area. 	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
723	Simhadri-II (2X500 MW) II-A5 1-General Layout Plan					NTPC to note that stage-I existing facilities like existing duct, pipe racks, ID fans, duct from ESP to ID fans, existing workshop building etc are not shown in the GLP received along with tender. NTPC is requested to provide the updated GLP to plan FGD layout at our end.	Please refer latest GLP for latest area/ blocks marked for FGD purpose being issued as an amendment.
724	NTEQL Vallur (3X500 MW) - Vallur GLP					NTPC to provide Coal conveyor drawings between TP5 & TP6 for planning of FGD facilities.	Available drawing shall be provided during detail engineering
725	NTPC Talcher Kaniha (6X500 MW) - Talcher GLP					As per GLP, Bidder noticed there are Conveyor, FO Tanks, Rail tracks and PIPE CUM CABLE RACK across FGD Space allocated area. Bidder requests NTPC to provide detail elevation drawings of the same. 1. Stage-I, ID system elevation and plan drawing 2. Stage-I, Equipment Layout Plan 3. Stage-I, Pipe Cable Trestle Layout with foundation details 4. Stage-II, Equipment layout plan 5. Stage-II, Pipe Cable Trestle Layout with foundation details 6. Conveyor drawings between TP3 & TP4, TP15 & TP16 and TP23 & TP24. 7. PIPE CUM CABLE RACK across FGD Space allocated area. 8. AHP key plan of Stage-I, Stage-II and stage-III AHP facilities. 9. Stage-II & stage-III ESP switchgear room GA drawing along with foundation details drawing. The above drawing were asked in earlier clarification on draft tender, which are extremely essential for planning of FGD facilities.	Requested drawings "Equipment Layout Plan & Pipe Cable Trestle Layout" is not available with us.
726	NTPC Talcher Kaniha (6X500 MW) - Talcher GLP					NTPC to note that stage-I existing facilities like existing duct, pipe racks, ID fans, duct from ESP to ID fans, ESP switchgear building, other AHP facilities etc are not shown in the GLP received along with tender. NTPC is requested to provide the updated GLP to plan FGD layout at our end.	Bidder is requested to visit site for getting the required information not available in the drawing. Any further layout constraint shall be discussed during detail engineering.
727	NTPC Talcher Kaniha (6X500 MW) - Talcher GLP					NTPC to note that provided space for FGD is not sufficient to accommodate all 6 units absorber along with chimney. Hence, to accommodate all the absorber within the allocated space bidder request NTPC to shift the existing road by 15m towards the railway track, please refer below snap for further clarification.	Bidder to refer amended GLP

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
728	NTPC Talcher Kaniha (6X500 MW) - Talcher GLP					To accommodate the FGD facilities within the available space, Bidder requests NTPC to provide following additional space (Grid E 600-900, N 300- 600) 	Bidder to refer ammended GLP
729	For LOT-2 Layouts	General		GLP for Lot-2 tender for all projects.		Bidder has considered the space as allocated in the general layout plan drawing and based on the site visit. This is done to accommodate various equipments / system of FGD as per tender specification. Bidder requests NTPC to provide the space as identified, which is clear without any obstruction at the time of award of contract. Please confirm.	Bidder to refer clause 1.11.00 of Sub-section-III Part-A of technical specification in this regard.
730	For LOT-2 Layouts	--	--	GLP for Lot-2 tender for all projects.		As seen from the GLP of various projects the space earmarked for FGD system is inadequate. To accommodate FGD system, some facilities like roads are to be relocated. Bidder request owner to take a note of the same and make necessary arrangement for such re-locations.	Bidder to refer clause 1.11.00 of Sub-section-III Part-A of technical specification in this regard.
731	SECTION-VI, PART-A SUB-SECTION-III-A1 (FGD)	14.00.00	07 of 09		The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc. .. required for the complete process operations.	Due to space constraint in the Layout, Bidder has considered existing Owner's pipe racks for routing pipes / cables (tapping from terminal points) related to FGD system. In other areas with in FGD, new trestle as required. Please confirm.	NTPC requirement shall be complied with.
732	For LOT-2 Layouts	-	-	-		Bidder has considered that the GLP provided by NTPC are final and the sizes and orientations of the buildings/ structures indicated in the same are 'not to exceed'. Bidder shall plan FGD system facilities and duct layouts accordingly. Any modification required in duct layout due to variation in building/ structure size shall be compensated by Owner.	Bidder is requested to visit site for getting the required information. Bidder to refer clause 1.11.00 of Sub-section-III Part-A of technical specification in this regard.
733	Section- VI, Part-B Bid Doc. No. CS-0011-109(2)-9	Sub-Section I-M6 - Limestone & Gypsum Handling system	6 of 41	4.04.00	Dust Extraction system - Venturi Scrubber Type	For limestone handling system, it is generally recommended to provide dry type DE system and the same is followed in NTPC - LOT-1A & 1B tenders. Please confirm.	Confirmed. Refer amendment No.-1
734	Section- VI, Part-A Bid Doc. No. CS-0011-109(2)-9	Sub-Section III-A5- Limestone & Gypsum Handling system	3 of 4	3.04.00	Complete dust extraction system ...	As gypsum generated is with moisture of 10% (max.), there shall not be any dry dust. Dust extraction system will work only for the dry material. Hence we do not recommended to provide any kind of dust extraction system for gypsum handling system. Please confirm.	Bidder to comply with specification requirement.
735	Section- VI, Part-B Bid Doc. No. CS-0011-109(2)-9	Sub-Section I-M6 - Limestone & Gypsum Handling system	28 of 41	1.7.0	Datasheet of Limestone crusher - Limestone feeding arrangement - through vibrating screen feeder arrangement.	As the two clauses are contradictory, Bidder presumes that vibrating feeder to be considered. NTPC to please check and confirm.	Vibrating feeder to be provided as per Clause No. 3.1.3. Refer amendment no.-1 for Datasheet of Limestone crusher.
	Section- VI, Part-B Bid Doc. No. CS-0011-109(2)-9	Sub-Section I-M6 - Limestone & Gypsum Handling system	2 of 41	3.1.3	In limestone crusher house, limestone from each incoming conveyor shall pass through (1) no. of dedicated vibrating feeder ...		
736	-	-	-	-	Seve analysis & Material CharacteristicS/ Physical properties for the limestone as received input	Please furnish us feed sieve analysis, material characteristics/ Physical properties and typical distribution of limestone (unloaded through trucks) for selection of the limestone crusher.	Bidder to consider suitable sieve analysis for ROM limestone available for this application. For material characteristics/ Physical properties consider relevant section.
737	Section-VI, Part-B Bid Doc. No. CS-0011-109(2)-9	Sub-Section I-M1 - Limestone & Gypsum Handling system	25 of 46	7.04.09	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the contractor.	Gypsum cake from the vacuum belt filter shall be directly fed to the dedicated belt conveyor through the chute. Hence, Hopper arrangement is not required. NTPC to confirm.	Bidder to comply requirements of the specifications.
738	SECTION – VI, PART-B	SUB-SECTION-I-M1 (FGD)	4.01.02	10 OF 52	(ix) Pressure drop considered for FGD & De-NOx systems in existing ID fan in: 550 mmWC	Please clarify whether this pressure drop is with margin or without margin..	NTPC clarified that booster fan shall be provided in Bourkela project, only if the required pressure drop (including margin) as per the specified criteria in the FGD system, exceeds this specified pressure drop considered in the existing ID fan.
739	SECTION – VI, PART-B	SUB-SECTION-I-M1 (FGD)	5.01.00 B	15 OF 52	However, 3 x 50% Gas Cooling Pumps instead of Slurry Recirculation shall be provided.	Please modify the clause as "3 x 50% or 2x100% Gas Cooling Pumps instead of Slurry Recirculation shall be provided." The best option shall be selected by the bidder.	Bidder to comply requirements of the specifications.
740	SECTION – VI, PART-B	SUB-SECTION-I-M1 (FGD)	5.03.02	16 OF 52	Absorber Oxidation Systems: Head: For Bubbling Type process.....or minimum 3500 mmwc whichever is higher.	Bidder request NTPC to modify the clause as, "Absorber Oxidation Systems: Head: For Bubbling Type process.....or minimum 3000 mmwc whichever is higher."	Bidder to comply requirements of the specifications.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
741	SECTION – VI, PART-B	SUB-SECTION-I-M 1 (FGD)	5.06.23	21 OF 52	The Screens shall be made of made of Alloy 59 / C276 or abrasion resistant FRP/ Polypropylene (in case Contractor/ Collaborator has proven experience).	Bidder request NTPC to modify the clause as, "The Screens shall be made of made of Alloy 59 / C276 or SS316L or abrasion resistant FRP/ Polypropylene (in case Contractor/ Collaborator has proven experience)."	Bidder to comply requirements of the specifications.
742	SECTION – VI, PART-B	SUB-SECTION-I-M 1 (FGD)	5.02.00	15 OF 52	Absorber includes side entry agitators, the contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (ntotal no. of working agitators). In case vertical agitators in Absorber are offered, one complete mechanical assembly of agitator shall be supplied as warehouse spare for each Absorber.	Bidder request NTPC to modify the clause as, "In case vertical agitators in Absorber are offered, one complete mechanical assembly of agitator shall be supplied as warehouse spare for each Absorber or shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (n, total no. of working agitators >3)."	Bidder to comply requirements of the specifications.
743	SECTION-VI, PART-A	SUB-SECTION-III-A4	6.03.00	6 of 88	g) Interconnection between the clarified water outlet channel and outlet channel Existing clarifier.	Kindly provide the location at which FGD clarifier outlet is to be connected to existing clarifier outlet.	Necessary Amendment is being issued.
744	SECTION-VI, PART-A	SUB-SECTION-III-A4	6.03.00	6 of 88	i) Necessary piping, valves, control and instrumentation etc arrangement for Tap off from the existing chlorine dosing system of S I/ S-II.	(i) Kindly furnish terminal point location, terminal point parameters like flow, pressure, temperature, pipe size, dosage rate, etc of existing chlorine dosing system. (ii) Since chlorination is not in Bidder's scope, Bidder understands that no approval from statutory body like COOE is in Bidder's scope. Please confirm Bidder's understanding.	Exact Details will be finalized during detail engineering.
745	SECTION-VI, PART-A	SUB-SECTION-III-A4	6.05.00	7 of 88	a) Preparation and dosing system equipments shall be installed in the existing chemical house of the stage-II.	Please provide the tentative routing of dosing lines from existing chemical house to FGD PT plant.	Exact Details will be finalized during detail engineering.
746	SECTION-VI, PART-A	SUB-SECTION-III-A4	(VII) – Horizontal Centrifugal Pump	14 of 88	Raw water Pump: Raw (sweet water) water pump house of S-II (2X500MW)	Please furnish tentative routing for raw water supply line to FGD PT plant which Bidder can follow/utilise.	Routing will be finalized during detail engineering.
747	SECTION-VI, PART-A	SUB-SECTION-III-A4	b) Chemical House	21 of 88	1) The chemical tank which is proposed to be used for preparation and supply of chemicals at any instant shall be selectable through control system.	Generally for PT plant, all chemical tanks outlet valves are manual valves and the same is also shown in NTPC's tender P&IDs. Hence, please elaborate this requirement.	Bidder to comply requirements of the specifications.
748	SECTION-VI, PART-A	SUB-SECTION-III-A4	7.06.00	28 of 88	23) Chlorination (if required) shall be suitably taped off from the existing CW chlorination system located nearby CW pump house alongwith necessary piping, valve, control & instrumentation etc.	Kindly furnish the location, tentative routing and terminal point parameters like flow, pressure, temperature, pipe size, dosage rate, etc of existing chlorine dosing system.	Exact Details will be finalized during detail engineering.
749	SECTION-VI, PART-A	SUB-SECTION-III-A4	7.06.00	28 of 88	25) Required number of lifting bar, dial type load indicator, electrically operated mono rail hoists for handling chlorine tonners	Please note that chlorination system is not in Bidder's scope. Hence, handling for chlorine tonners shall not be in Bidder's scope. Please confirm.	Necessary Amendment is being issued.
750	SECTION-VI, PART-A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.05.00	2 of 3	Sea water PT & Desalination plant applicable for Vallur TPP: i) Contractor shall take a tap off suitably from the existing CW blow down header (To CMB) available near the proposed Sea water PT & Desalination plant (as indicated in GLP). ii) Contractor shall terminate the discharge of backwash, cleaning & chemical waste and PT plant sludge into the existing CW blow down header (To CMB) available at 200 meter downstream of intake point to sea water PT & desalination plant.	i) Please furnish the flow, pressure, temperature available at terminal point and its location. ii) Please furnish the terminal point pressure at which Bidder shall terminate the discharge and its location.	Exact details will be furnished during detail Engineering.
751	SECTION-VI, PART-A	SUB-SECTION-V	1.00.00	1 of 21	SALIENT DESIGN DATA	Please provide the value of NOx in flue gas composition	FGD system shall be designed using the data given in the salient design data.
		SUB-SECTION-V	2.00.00	3 of 21	SALIENT DESIGN DATA	Please provide the value of NOx in flue gas composition	FGD system shall be designed using the data given in the salient design data.
		SUB-SECTION-V	3.00.00 A	5 of 21	SALIENT DESIGN DATA	Please provide the value of NOx in flue gas composition	FGD system shall be designed using the data given in the salient design data.
		SUB-SECTION-V	3.00.00 B	7 of 21	SALIENT DESIGN DATA	Please provide the value of NOx in flue gas composition	FGD system shall be designed using the data given in the salient design data.
752	VI - A	II - A5	22 of 30	Annexure IV	--	FGD facilities for Bhilai Package: Bidder requests NTPC to share borehole details for locations adjacent to identified FGD space.	Available data has already been furnished
753	VI - A	II - A3	21 of 29	Annexure III	--	FGD facilities for Sipat Package: Bidder requests NTPC to share borehole details for locations adjacent to identified FGD space.	Available data has already been furnished
	SECTION – VI / PART-E	0011-109(2)-P0E-J001/B		Note no. 10	Sipat-I & Vallur: Two numbers 11kV motors per unit shall be fed from existing spare feeders in station boards as indicated in tech. spec. Necessary augmentation and modification required in switch gear panels for this purpose shall be in scope of bidder.		Same shall be furnished to successful Bidder during detailed Engineering. However, Bidder may visit Site for details and assessment

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
754	SECTION – VI / PART-E	0011-109(2)-P0E-J001/F		Note no. 10	Rourkela: Two numbers spare panels in owners station switchgears shall be suitably modified to DEtype for feeding of 6.6 kv FGD tie switchgears.	Request Employer to share the drawings- GA and SLD of existing Switchgear. Same is required for estimating the cost of augmentation and modification of these feeders.	of existing equipment.
	SECTION – VI / PART-E	0011-109(2)-P0E-J001/E		Note no. 10	Bhilai: Two numbers 6.6 kv motors per unit shall be fed from existing spare feeders in unit boards as indicated in SLD. Necessary augmentation and modification required in switch gear panels for this purpose shall be in scope of bidder.		
755	SECTION – VI / PART-E	0011-109(2)-P0E-J001/C			Talcher STPP-I & II : 11 KV FGD Switchgear Scheme 3.3 KV FGD Switchgear Scheme	Bidder proposes to have single 11 kv tie Switchgear and 3.3 KV tie Switchgear for all the four units in line with other LOT-2 projects. Please concur.	refer ammendment to tender SLD
756	SECTION – VI / PART-E	0011-109(2)-P0E-J001/C		Note no. 8	Talcher STPP I & II : Three numbers DG set for entire FGD plant shall be provided by the bidder for meeting the emergency load envisaged.	Bidder proposes to have only single DG for entire FGD system as a whole in line with other LOT2 projects. This DG shall feed the emergency MCC(common for entire Plant). Please concur	refer ammendment to tender SLD
757	SECTION – VI / PART-E	0011-109(2)-P0E-J001/E		Note no. 7	Talcher STPP I & II: Bidder shall provide 03 nos. DC system of adequate capacity for meeting DC loads in FGD area.	Bidder proposes to have only 01 nos 220 V DC system for entire FGD system as a whole. Please concur	refer ammendment to tender SLD
758	SECTION – VI, PART-B	SUB SECTION II-E-19	38 of 44	8.07.05 c)	For Step and Touch potential the following parameters shall be considered i) Current distribution factor – 1 (One) ii) Duration of fault current - 0.5 sec iii) Human body weight - 50kg	Bidder understands that separate touch & step potential calculation is not required for FGD package. However necessary supporting calculations shall be submitted for maintaining the ground grid resistance less than 1 ohm. Please confirm.	Bidders understanding is Correct
759	SECTION – VI / PART-A	SUB-SECTION-IV	2 OF 3	1.04.00	Process Water For process water requirement, Contractor shall take a tap off suitably from the existing blow down header available near FGD area except for coastal projects(Smhadr STPP & Vallur TPP).	Employer to note that in general,process water tap off point are quite away from space provided for FGD. Hence, Bidder requests Employer that wherever applicable, process water booster pump (in FGD scope) can be fed from near by client switchgear in case the tap off point is far away from FGD area. Employer to concur.	The same shall be finalized during detailed engg. Based on availability of nearby switchgear.
760	SECTION – VI / PART-B	SUB-SECTION-II-E21	13 of 17	5.07.01	Lightning protection system shall conform to IS:2309. It shall comprise vertical air termination, horizontal air termination, down conductor, test links, earth connections and earth electrodes.	Please note that IS2309 has been withdrawn. Bidder understands that IEC-62305 shall be used for lightning protection system design in absence of IS. Employer to confirm.	Confirmed
761	Section-VI, Part-B	SUBSECTION-II-E15 LIGHTING	7 of 18	4.00.00 ; 10 (a)	Lighting panels shall have min. IP55 degree of protection.	Bidder understands that outdoor lighting panels shall have IP55 degree of protection. However, IP54 shall be provided for indoor lighting panels. Owner is requested to confirm.	Technical specifications are clear. Bidder to comply with clause no 4.00.00.10(a) of Sub section II-E15 of technical specifications
762	Section-VI, Part-B	SUBSECTION-II-E15 LIGHTING	8 of 18	4.00.00 ; 10 (i)	LP-1 3No. 415V, 32 A, TP MCB (31/2Cx70sq.mm cable) LP-2 3No. 415V, 32 A, TP MCB (31/2Cx35sq.mm cable) LP-D1 1No. 220V,32 A, DP Isolator (2Cx35sq.mm cable)	Bidder understands Cable size requirement mentioned in lighting panel section is indicative only. Bidder shall select required size of cables as per sizing criteria. Please confirm.	Technical specifications are clear. Bidder to comply with clause no 4.00.00.10(i) of Sub section II-E15 of technical specifications
763	Section-VI, Part-B	SUBSECTION-II-E15 LIGHTING	11 of 18	4.07.00	Occupancy based Passive Infra-red sensors The sensors shall be recess mounted, programmable type suitable for lighting load of 6A with variable off delay settings.	Please note that as per general industrial practice,Bidder will consider occupancy based passive Infra-red sensors in area like Office, Conference room & Control Room. Owner is requested to confirm.	The same shall be finalized during detailed engg in line with GRIHA requirement
764	SECTION – VI / PART-B	SUB-SECTION-II-E6	5 of 23	3.02.05 (a)	FOR COAL HANDLING PLANT/FGD PLANT AREA THE FOLLOWING SHALL ALSO BE APPLICABLE:- All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cable shall be laid in vertical trays. Directly buried cable, if essential shall not have concentration of more than 4 cables on one route	Please note that for Talcher STPP, there shall be cables coming from Switchyard area to FGD area. Employer is requested to suggest cable route and raceway for the same.	Bidder may visit the project in order to get itself acquainted with existing electrical of plant
765	SECTION – VI / PART-A	SUB-SECTION-I	16 OF 21	4.03.00	PROVENNESS CRITERIA FOR ELECTRICAL EQUIPM ENTS 4.03.07 SWITCHYARD 220KV EQUIPM ENT 220kV Circuit Breakers being offered should be from Manufacturer who has manufactured and supplied atleast five(5) nos. of three phase circuit breakers suitable for Air Insulated Substation/ Switchyard of 220 kV or above class which should have been in successful operation for at least two(2) years.	As per this clause of proveness criteria, bidder understands that for extension of 220kV bay in Talcher, it is not necessary to have switchyard equipment of same make as that of existing switchyard equipment make. Please confirm.	Bidders understanding is Correct
766	SECTION- VI, PART-A	SUB-SECTION-IV	3 OF 3	1.13.01	Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in relevant clauses for SCOPE is given below: i) Employer's HT switchgear ii) Employer 220kV Bus at Switchyard (For TS/TPS only)	For TS/TPS,Bidder proposes that if there is spare availability(of adequate capacity) in the existing station/ Unit switchgear then modification/extension of transformer bay in existing switchyard may not be required.Request employer to please check and confirm the same.	Power supply for FGD system in TS/TPS shall be derived from 220kV switchyard as per tender SLD.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
767	TSTPS-I& II (6X500 MW) II-A1-1-General Layout Plan				400KV SWITCHYARD	Please note that referred two drawings are contradictory. General layout indicates 400KV switchyard and SLD indicates 220kV. Please clarify.	Owner's existing 220kV switchyard is located in Stage-I Switchyard area. Bidder may visit Site for
768	SECTION – VI / PART-E	0011-109(2)-POE-J-001/ C			230KV SWITCHYARD		
769	SECTION – VI / PART-E	0011-109(2)-POE-J-001/ C			220/34.5kV	Please note that there shall be no FGD loads that needs 33kV voltage supply. Hence, Bidder propose to have 220/11kV transformer that shall further feed 11kV switchgear. Instead of having 33kV voltage intermediate switchgear in between. Please concur.	Bidder to provide supply arrangement as indicated in tender SLD.
770	TSTPS-I& II (6X500 MW) II-A1-1-General Layout Plan					General layout of Talcher does not indicate any space allocated for extension of switchyard for FGD, and further placement of 220/34.5kV transformer and 33kV switchgear. Request employer to indicate the same.	Two(2) nos. additional 220kV bays, transformers and 33kV switchgear building shall be placed in switchyard area. Also refer Amendment to tender GLP
771	VI/ A	IIIC	3 of 19	1.02.01 (F)	Twisted pair with round steel wired armour (SWA), Type A fieldbus cable complying to 61158 (detailed Specification as per PART-B), ...for fieldbus based instruments and actuators shall be provided by the contractor under this package	Bidder understands that Fieldbus Trunk cable shall be Single pair as per IEC-61158 Type-A specification. Accordingly, Instrumentation cables other than Fieldbus cables, shall be minimum 4 pair type for connection between field/ JB and DDCMIS. Kindly confirm / clarify.	The requirements of fieldbus cables and instrumentation cables are different. The fieldbus cables are to provided as per referred clause 1.02.01 (F). Regarding instrumentation cables (F type/ G type), bidder's understanding is correct.
	VI/ B	III-C5	18 of 22	8.03.08 (b)	Minimum 4 pair Instrumentation Cables shall be used for connection between field/ JB and DDCMIS marshalling cabinet ...		
772	VI/ A	IIIC	4 of 19	2.02.01 (b)	Common system process blocks: i. Gypsum De watering Handling common system block. ii. Lime stone preparation and handling common system block. iii. Other associated common system including RO based Desalination system, Water treatment system (as applicable)	Bidder understands that a common process block can be considered including all common systems like Gypsum Dewatering / handling, Limestone preparation / handling, water treatment system etc. Kindly confirm / clarify.	Bidder's understanding is not correct. It is clarified that as per referred clause, three Common system process blocks are envisaged as mentioned below : i. Gypsum De watering Handling common system block. ii. Lime stone preparation and handling common system block. iii. Other associated common system including RO based Desalination system, Water treatment system (as applicable)
773	VI/ A	IIIC	5 of 19	2.04.02	Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply.	Kindly inform the cable route length to be considered for the same.	Tentative cable route length between ACDB to FGD OWS (located in CCR) shall be 200 meters approximately.
774	VI/ A	IIIC	7 of 19	2.10.00 (b)	Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/ SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/ SWGR etc.	Bidder understands that either separate marshalling cabinet or system cabinet with partition for marshalling, can be considered as per OEM's standard & proven practice. Kindly confirm / clarify.	Bidder's understanding is correct. However, bidder to comply with the specification requirement mentioned in the referred clause 2.10.00.
	VI/ A	IIIC	7 of 19	2.10.00 (e)	In case DDCMIS supplier can provide system cabinet with suitable partition to create separate marshalling area on the rear side of the system cabinet, ensuring that dust ingress does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage.		
775	VI/ A	IIIC	12 of 19	3.03.01, Notes: 9	Analizers mentioned in S.No. 1 to 7 of the above list of flue gas analyzers for CEM S are not applicable for NSPCL Rourkela (1x250MW) project.	Bidder understands that for NSPCL Rourkela (1x250MW) project, all CEMS related supply and services are excluded from Bidder's scope. Kindly confirm / clarify.	Bidder's understanding is correct.
776	VI/ A	IIIC	12 of 19	3.03.02	Bidder shall connect analysers instruments of his scope and provide single point/ port for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer.	Bidder understands that Bidder's Terminal point for the same shall be at a single point/ port near Bidder's CEMS. Kindly confirm / clarify.	Refer Amendment in this regard.
777	VI/ A	IIIC	16 of 19	10.00.00	Interfacing with Employer's DDCMIS	Bidder understands that necessary hardware / software modifications as required at Employer's System end, to interface with Bidder's system, shall be in Employer's scope. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/ A	IIIC	5 of 19	2.04.02	A redundant station-wide LAN for ... connecting to Employer's Station LAN through firewall. This shall include all cables and accessories required for connecting Contractor's system upto the Employer's systems such as Station LAN, etc.		
	VI/ A	Appendix-I to Part- A	2 of 2	Note:3	Redundant Master Clock are located in CER. Interconnecting cables shall be on as required basis.		

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
778	VI/ A	IIIC	16 of 19	10.01.00	Hardwired signal exchange between BOP DDCMIS/ CHP DDCMIS (under Employer's scope) and FGD DDCMIS	Bidder understands that with respect to Limestone unloading through road, Limestone Handling system shall be independent of Coal Handling System. Accordingly, no interface of FGD DDCMIS is envisaged with CHP DDCMIS.	Bidder's understanding is correct in view of limestone transportation through road.
	VI/ A	III-A5	1 of 4	2.01.01	Limestone will be received to power plant through road by trucks...	Kindly confirm / clarify.	
779	VI/ A	IIIC	16 of 19	10.01.00	Cabling from DCDB to RIO panel (located in CER) shall be in bidder's scope of supply.	Kindly inform the cable route length to be considered for the same.	Tentative cable route length between DCDB to RIO panel (located in CER) shall be 200 meters approximately.
780	VI/ B	III-C5	2 of 22	1.06.04	In order to achieve above, following shall be redundant with automatic change-over (including the associated software), as a minimum: ... Output modules ...	Bidder understands that Output redundancy shall be considered as specified in Volume-VIA, Sub-Section-III C.No 2.15.00.	Bidder's understanding is correct and accordingly output redundancy shall be considered for 10% of all type of drives.
	VI/ A	IIIC	9 of 19	2.15.00	Output redundancy is applicable for 10% of drives including MOVs, Pneumatic On/Off / Control valves, Electrical breakers etc. distributed in various functional groups. Exact application shall be finalized during detailed engineering.	Kindly confirm / clarify.	
781	VI/ B	I-M6	28/ 29 of 41	4.0.0	Specification of the Vibration Monitoring System	Bidder understands that Vibration Monitoring system specification for complete FGD system (including Crushers), shall be as specified in Volume-VIB Sub-section III-C2. Accordingly, VMS specification in Sub-section I-M6 C.No.4.0.0 shall be superseded.	Bidder's understanding is correct. Refer amendment in this regard.
	VI/ B	III-C2	32 of 40	12.00.00	Vibration Monitoring System	Kindly confirm / clarify.	
782	VI/ B	I-M6	31 of 41	6.3.01	Limestone & Gypsum Handling Plant Main Control Room ...	Bidder understands that no separate Control room is envisaged for Limestone/ Gypsum Handling, and the same shall instead be read as 'FGD Control Room'. Kindly confirm / clarify.	Bidder's understanding is correct.
783	VI/ B	I-M6	36 of 41	6.06.02	Status indications in Large Video Screen Following individual status indications shall be provided in LVS with individual ON/OFF/ TRIP indications on CRT.	Bidder understands that no LVS is envisaged for the FGD system as per Appendix-I to Part- A, Section-VI. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/ A	IIIC	3 of 19	2.01.00	The contract quantity of hardware and peripherals of HMIPIS, programming station etc. shall be as per Appendix-I to Part- A, Section VI of Technical specification read in conjunction with detailed technical specification.		
784	VI/ B	I-M6	36 of 41	6.07.00	DDCMIS Control desk shall be provided with adequate number of facia type annunciation windows operating through DDCMIS for the following audio-visual fault annunciation purposes.	Bidder understands that all annunciations are envisaged through OWS, and no hardwired facia type annunciation is envisaged for the same.	Bidder's understanding is correct.
	VI/ B	III-C5	14 of 22	5.02.01	The OWS annunciation will replicate in software the salient features of conventional hardware annunciations facia (for permanent viewing i.e., not operator changeable) while presenting more flexibility.	Kindly confirm / clarify.	
785	VI/ B	I-M6	36 of 41	6.06.02 (m)	...Further Mimic lamps for HT and LT SLDs shall be provided on the control desk.	Bidder understands that no mimic lamp related arrangement on Control Desk is envisaged dedicatedly for Handling system SLDs, inline with NIT VI-A Sub-Section-III C. Kindly confirm / clarify.	Bidder's understanding is correct

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
786	SECTION-VI, PART-A	SUB-SECTION-III-A4	6.03.00	6 of 88	Two of reactor clarifier (both working) of ROC construction each of capacity as mentioned in datasheet.	Please note that there is discrepancy in the capacity of clarifier between the mentioned clauses. i) As per cl.7.07.00 total water available is 530 m3/ hr. As per datasheet cl. 6.07.00, design flow of each clarifier is 460 m3/ hr whereas as per guarantee clause 4.02.00, capacity of each clarifier shall not be less than 280 m3/ hr. Kindly clarify.	Necessary Ammendement is being issued.
	SECTION-VI, PART-A	SUB-SECTION-III-A4	6.07.00	10 of 88	II) Clarifiers Design Flow- 460 m3/ hr.		
	SECTION-VI, PART-A				(xvii) Clarification Plant (Applicable for Smhadri) a) Each clarifier unit of PT-CW system shall be guaranteed for an effluent capacity of not less than 280 cum/ hr meeting the effluent quality as mentioned below.		
	SECTION – VI, PART-B	SUB-SECTION-VI	4.02.00	16 of 27	Total water (ACW/Process water + (plus) Gypsum washing water for Smhadri STPP- I & II (2x500 MW) & (2x500MW)		
		SUB-SECTION-I-M5	7.07.00	10 of 152	530 m3/ hr		

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
787	Part A/ Sec IV	III-A4	6 of 88	6.03.00. e)	Two (2) numbers of reactor type clarifiers (<u>Both working</u>) of RCC Construction each of capacity as mentioned in the data sheets including associated equipment and drives.	Bidder understands that <u>2 x 50%</u> capacity clarifiers with shall be provided. Further Bidder understands that the design flowrate of <u>each Clarifier</u> shall be 230m ³ /hr (with total design flow of 460 m ³ /hr).	As mentioned in the Q No 9.07.00 (II) , Sub-section-A4, Page 9 of 88 , Design flow of clarifier shall be 460 m ³ /hr. Bidder to comply the specification requirement .
	Part A/ Sec IV	III-A4	10 of 88	6.07.00. II)	Clarifier 3) Design Flow -460 m ³ /hr		
788	Part A/ Sec IV	III-A4	6 of 88	6.03.00. g)	Interconnection between the clarified water outlet channel and outlet channel Existing clarifier .	Bidder would like to clarify that interconnection between clarified water outlet channel and outlet channel of existing clarifier would not be provided.	Bidder to comply the specification requirement.
789	Part A/ Sec IV	III-A4	6 of 88	6.04.00. b)	Hot secondary water pipe (ACW) from the PHE's, discharging into the FGD system as process water. Provision for recirculation of hot secondary water line to <u>ACW tank</u> shall also be provided.	Bidder would like to clarify that separate ACW tank is not provided. Furthermore, provision for recirculation of hot secondary water line to clarified water storage tank is not envisaged as per process requirements and would not be considered. Please confirm.	Bidder to note that Clarified Water storage tank / Distribution Chamber and ACW tank are same.
790	Part A/ Sec IV	III-A4	6 of 88	6.05.00. b)	Lime preparation & dosing system consisting of required number of RCC lime slaking tanks, <u>RCC lime solution preparation tanks</u> , agitators, lime slurry transfer pumps, lime solution dosing pumps complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc as mentioned data sheets enclosed in Annexure-1 of this sub-section.	Bidder would like to clarify that based on the capacity of the tank calculated either RCC or metallic (suitable compatible material) tanks would be provided. Please confirm.	Bidder to comply the specification requirement.
	Part A/ Sec IV	III-A4	6 of 88	6.05.00. c)	Alum Solution preparation & dosing system consisting of required number of <u>RCC Alum solution preparation tanks</u> , agitators, alum solution dosing pumps complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc as mentioned data sheets enclosed in Annexure-1 of this sub-section.		
791	Part A/ Sec IV	III-A4	22 of 88	7.02.00. a)	CW blow down water pipe tapped at the nearest point from CW blow down header to CMB to a stilling chamber, one set of Control Valve, its bypass valve and Isolation Valves for Control Valves.	Bidder understands that the CW system in the existing plant is once through system and hence the Seawater quality provided will be considered as design input for PT & Desalination Plant, without considering Cycles of concentration (COC) on water quality.	CW system in the existing plant is running at 1.5 COC, hence the design sea water quality shall be calculated accordingly. Necessary amendment is being issued.
	Part A/ Sec IV	II-A4	33 of 37	PROJECT INFORMATION (VALLUR TPP 3X500 MW)	TABLE-4 SEA WATER ANALYSIS		
792	Part A/ Sec IV	III-A4	24 of 88	7.03.00. iii)	Complete Chemical cleaning and Flushing system comprising the necessary tanks and pumps for SWRO trains/ streams.	Bidder would like to propose <u>One (1) no. common Chemical cleaning system</u> for both SWRO and BWRO Units depending on Manufacturers recommendation, instead of separate chemical cleaning system for SWRO and BWRO Units. Please confirm.	Bidder to comply the specification requirement.
793	Part A/ Sec IV	III-A4	25 of 88	7.04.00. d)	Complete system for chemical cleaning and Flushing system comprising the necessary tanks and pumps for RO trains/ streams.		
794	Part A/ Sec IV	III-A4	25 of 88	7.04.00. g)	Reject water piping from 2 nd stage RO trains to the Brine water storage tank.	Bidder would like to propose that BWRO reject water may be recirculated back to the Filtered water storage tank (downstream of Dual Media Filters). Please note that BWRO reject water quality is much better than the SWRO inlet water quality.	Bidder to comply the specification requirement.
795	Part A/ Sec IV	III-A4	26 of 88	7.06.00. 3)	Two numbers of Coagulant preparation tanks & its accessories	Bidder would like to clarify that there are no chemical dilution required for chemicals such as coagulant (FeCl ₃), anti-scalant, HCl and NaOH, before dosing. Hence, Bidder proposes to provide required Bulk storage tanks and one (1) no. dosing tank (for each chemical) of one day capacity required. Please confirm.	Bidder to comply the specification requirement.
796	Part A/ Sec IV	III-A4	26 of 88	7.06.00. 7)	Two numbers of Anti-scalant preparation tanks & its accessories		
797	Part A/ Sec IV	III-A4	27 of 88	7.06.00. 13) & 14)	Three numbers of Acid (HCl) preparation tanks & its accessories Two numbers of Acid (HCl) measuring tanks & its accessories		
798	Part A/ Sec IV	III-A4	27 of 88	7.06.00. 19) & 20)	One number of Alkali preparation tank & its accessories		
					Two numbers of Alkali measuring tanks for pH control of RO System & its accessories		

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
799	Part A/ Sec IV	III-A4	27 of 88	7.06.00	16) Two numbers of Sodium Hydroxide (Alkali) unloading pumps, its drives, required suction & discharge piping, valves, fittings etc. 17) Two numbers of Sodium Hydroxide (Alkali) transfer cum recirculation pumps, its drives, required suction & discharge piping, valves, fittings etc.	Bidder would like propose 2 x 100% Sodium Hydroxide (Alkali) unloading cum transfer pumps which can unload the chemical from the chemical tanker to bulk storage tanks and also can transfer chemicals from bulk storage tank to day tank. Please confirm.	Bidder to comply the specification requirement.
800	Part E/ Sec VI	-	1 of 2	0011-109(2)-POM -A-005	P&ID for Pre-Treatment Plant (Sheet-1) for Smhadri STPP	Bidder understands that Owner will provide a service water connection from the existing overhead tank header for dilution of chemicals and flushing purposes. Please confirm.	Bidder to take necessary tapoff from the nearest available overhead tank header.
801	Part E/ Sec VI	-	1 of 2	0011-109(2)-POM -A-005	P&ID for Pre-Treatment Plant (Sheet-1) for Smhadri STPP	Owner has indicated "Filter backwash pump discharge" line connected to the "stilling chamber". However, please note that there are no Media filters proposed / required for this project as per specification. Please clarify.	Bidder's understanding is correct. Filter Back wash pump discharge in the P & ID is not required and same may be considered as deleted.
802	Technical Specification- Section VI, PART -A BID DOC NO CS-0011-109(2)-9	II-A5 PJ INFORMATION,(BHILAI - 2 X 250 MW) II-A6 PJ INFORMATION,(MUZAFIRPUR-II 2 X 195 MW) II-A7 PJ INFORMATION,(ROURKELA 1 X 250MW) II-A2 PJ INFORMATION,(SIM HADRI -4 X 500MW) II-A4 PJ INFORMATION,(VALLUR TPP 3X500MW)	BHILAI - 2 X 250 MW --> Page 21 OF 30 MUZAFIRPUR-II 2 X 195 MW--> Page 25 of 36 ROURKELA - 1 X 250MW --> Page 21 of 29 SIM HADRI -4 X 500MW --> Page 19 of 29 VALLUR TPP 3X500MW --> Page 24 of 37	ANNEX -III	Soil data and foundation system Employer has carried out geotech investigation in the vicinity of proposed area. Logs of available bore holes for bidder's solely information in the vicinity of the proposed area are enclosed with this annex	Requesting NTPC to provide the layout indicating location of Bore Holes provided with respect to the proposed space for F.G.D Plant	Borehole co-ordinate marked in the borelog. Bidder may refer the same
803	Technical Specification- Section VI, PART -A BID DOC NO CS-0011-109(2)-9	II-A3 PJ INFORMATION,(SPAT - 3 X660MW)	Page 19 of 29	ANNEX -II	Soil data and foundation system Employer has carried out geotech investigation in the vicinity of proposed area. Logs of available bore holes for bidder's solely information in the vicinity of the proposed area are enclosed with this annex	Requesting NTPC to provide the layout indicating location of Bore Holes provided with respect to the proposed space for F.G.D Plant	Borehole co-ordinate marked in the borelog. Bidder may refer the same
804	Technical Specification- Section VI, PART -A BID DOC NO CS-0011-109(2)-9	II-A1 PJ INFORMATION,(TSTPP - 6 X500MW)	Page 22 of 34	ANNEX -I	Soil data and foundation system Employer has carried out geotech investigation in the vicinity of proposed area. Logs of available bore holes for bidder's solely information in the vicinity of the proposed area are enclosed with this annex	Requesting NTPC to provide the layout indicating location of Bore Holes provided with respect to the proposed space for F.G.D Plant	Borehole co-ordinate marked in the borelog. Bidder may refer the same
805	Technical Specification- Section VI, PART -B BID DOC NO CS-0011-109(2)-9	IV - D CIVIL WORKS	Page 9 of 64	3.14.01 CHIMNEY	The Center to center distance between the proposed chimneys and the existing chimneys and NDCT's in any direction shall not be less than 150 m	Request to confirm whether the center to center distance between the two new chimneys needs to be a minimum of 150 m or is it only applicable for the center to center distance between new chimneys and existing chimneys.	The center to center distance of minimum 150m shall be kept between existing and new chimney. The distance between existing chimney's shall be as per design.
806	Technical Specification- Section VI, PART -B BID DOC NO CS-0011-109(2)-9	IV - D CIVIL WORKS	Page 13 of 64	3.14.08	Thermal insulation (application in case of titanium , C 276 Flue liner)	Bidder understands that thermal insulation is not required in case of 38 mm thick Borosilicate lining inside flue can	Bidders understanding is correct.
807	Technical Specification- Section VI, PART -B BID DOC NO CS-0011-109(2)-9	IV - D CIVIL WORKS	Page 34 of 64	22.00.00	Statutory requirements Bidder shall obtain approval of Civil/ Architectural drawings from Concerned authority before taking up construction	Bidder understand that Civil/ Architectural drawings for the project needs approval from "NTPC" only and does not need require approval from other external agencies.	Bidder to comply with technical specification
808	VI / A	III-B	3 of 8	1.05.03 / 1.06.00.(c)	It is in the interest of the bidder to acquaint himself with existing schematics and present scope before submission of offer.	1. Existing schematics of control and protection panel of switchyard. 2. Availability/ Ratings of spare module in existing ACDB / DCDB of existing switchyard 3. Existing switchyard control room details. 4. Existing switchyard plan and section layout. 5. Make of Existing Switchyard Equipments.	Bidder is requested to visit the site and collect the required details.
809	VI / B	II-E16	12 of 12	-	Block diagram of DC health monitoring system (drg. No. 0000-209-POEA-002)	Bidder understand this is not applicable to 220V DC system of FGD package/ FGD plant area, since DC health monitoring system is not covered in writeup portion of E16. Owner to check and confirm	Bidders understanding is correct.

CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
810	VI / E	-	61 to 66	-	Electrical Single Line Diagram for FGD Package (Drg.no.0011-109 (2)-POE-J001/A-F Rev A)	Owner to furnish the following details: 1. Existing Station boards details (SLD, Make) for Bidder's reference.	Relevant details shall be provided during detailed engineering.
811	VI / A	III-B	5 of 8	1.10.00 (2)	Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109 (2)-POE-J001/Rev.B on the employers nearest trestle in the FGD area as shown in GLP drawing of respective plant subject to availability of space and suitability.		Query is incomplete and not clear
812	VI / A	IV	3 OF 3	1.13.01	Employer's HT switchgear		Query is incomplete and not clear
813	VI / B	II-E6	22 of 23	9.00.00.b.1	Separate Switchgear Rooms shall be provided for each unit. For TG building, all HT boards shall be provided in HT switchgear room at only one floor and all LT boardsshall be provided in LT switchgear room at only one floor.	Bidder understands that this clause is not applicable for FGD Package. Please confirm. Switchgear rooms to be decided by bidder. Bidder will decide based on FGD layout	Bidders understanding is correct.
814	VI / A	III-B	2 of 8	1.05.02.I	Surge arrester	Location of surge arrester not clear in Tender SLD (Talcher STPS). One no. of surge arrester will be provided on 220kV side of FGD tie transformer	Bidders understanding is correct . Refer ammended tender SLD.
815	VI / A	III-B	3 OF 8	1.05.02.II	Material for earthing of all switchyard equipment	Below and above ground earthing of switchyard equipment which are in Bidder scope of supply and two connections will be provided / terminated to existing switchyard earth grid. NTPC to confirm.	Bidders understanding is correct.
816	VI / A	III-B	3 OF 8	1.05.02.II	Lighting and its accessories	Power supply for lighting of new 220kV dia (if required) shall be fed from existing MLDB in switchyard control room. Request NTPCto confirm.	Bidders understanding is correct.
817	-	-	-	-	GLP - Talcher	1. Request NTPCto identify space for two nos. of 220 / 34.5kV, 100 MVA (TYP) transformer near to switchyard area. 2. General Layout shows 400kV switchyard, whereas Specification/ Tender says 220 kV Switchyard. Please confirm the location of 220 kV Switchyard on layout. 3. Please provide overall cable tray layout to identify the routing of 33 kV Cable.	Refer ammendment to tender GLP
818	VI / B	II-E19	3 of 44	1.01.25	Two nos. of suitable separate power supply from LT switchgear shall be provided to each AC kiosk.	Two nos. of power supply for AC kiosk (if applicable) shall be derived from existing LT switchgear located in switchyard control room. Request NTPC to confirm.	Bidders understanding is correct.
819	VI / B	II-E19	33 of 44	Annexure I	Bay Kiosk	Control and protection panel are located in existing switchyard control room as per clause 1.06.00 part A, sub section IIIB. Hence, no separate Bay Kiosk is envisaged. NTPCto confirm the space availability at Existing Switchyard control Room to accomodate new switchyard panels.	Bidder's understanding is correct however bidder is requested to visit site for obtaining further details.

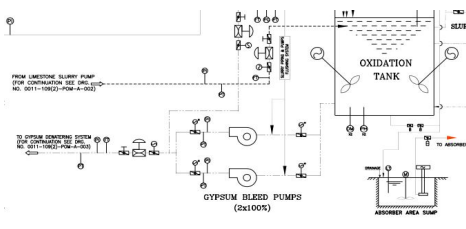
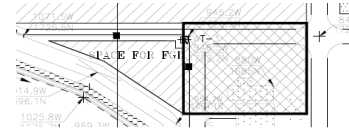
CLARIFICATION NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC'S CLARIFICATION
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
820	VI / B	II-E19	37 of 44	8.07.00	Cabling	A. Existing cable trays/ trench in switchyard control room shall be utilized for the following: 1. power from ACDB / DCDB to control and protection of new 220kV dia. 2. control cables 3. wherever possible, Existing cable tray shall be utilized from switchyard control room to switchyard. B. New cable trench and trays / conduit with support accessories will be provided by bidder in new 220kV dia of switchyard. Request NTPC to confirm.	Bidder understanding is correct. However it may be noted that incase space available in the existing tray/ trench is not sufficient than seprate arrangement for the cables in the bidder's scope shall also be in the scope of the Bidder.
821	IV/ A	-	3 of 3	1.13.01	Electrical Terminal Points ii) Employer 220kV Bus at Switchyard (For TSPS only)	Bidder presume bus extension is not required at TSPS 220KV Switchyard (Talcher STPS). NTPC to confirm the same	Bidders understanding is correct.
822	VI / B	II-E19	37 of 44	8.07.00	1.05.00	NTPC to confirm 220kV side voltage variation for TSPS (TALCHER).	Voltage variation for 220kV shall be from 198kV to 245kV as per Statutory regulations.
823	A5-1	-	-	-	General Layout Plan dwg for Bhilai 2 x 250 MW	Request NTPC to provide : Additional space required for 1. Limestone handling, 2. Integrated Ball mill & Gypsum dewatering building and 3. gypsum storage shed facilities.	Refer ammendment to tender GLP
824	A7-1	-	-	-	General Layout Plan dwg for Rourkela 1 x 250 MW	Request NTPC to provide : Additional space required for 1. Limestone handling, 2. Integrated Ball mill & Gypsum dewatering building and 3. gypsum storage shed facilities.	Refer ammendment to tender GLP
825	A1-1	-	-	-	General Layout Plan dwg for TSTPS 6 x 500 MW	Request NTPC to provide : Additional space required for 1. Booster fans 2. Space for Switchyard	Refer ammendment to tender GLP

CLARIFICATION NO. 3 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
1	VI/B	SUB-SECTION-I-M1 (FGD)	29 of 52	7.07.06	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	Bidder shall envisage 3 mm thick Flake glass (Vinyle ester based) lining for Waste Water tank as per Clause no. 10.01.00 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD): Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank: Vinyl Ester based flake glass lining of minimum 3 mm thickness. Clause No. 7.07.06 & 10.01.00 are contradictory to each other regarding lining material of waste water tank. So, bidder has considered lining material as per cl. no. 10.01.00... This is in line with clarification / reply / amendment received from NTPC for Lot 1A / Lot 1B tender.	Bidder's understanding is correct. The waste water collection tank shall be of Steel construction with Vinyl Ester based flake glass lining of minimum 3 mm thickness.
2	VI/A	SUB-SECTION-III-A1 FGD	6 of 9	7.08.00	All the storage tanks shall be lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness from inside.	Bidder shall envisage water tank linings as per Specification Clause no. 13.03.07 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD). CL. No. 13.03.07 provides the option of Epoxy lining, in addition to Rubber/ Flake glass lining mentioned in cl.no. 7.08.00.. So, bidder will consider Rubber/ Flake glass/ Epoxy lining. Employer to confirm bidder's consideration.	NTPC clarified that the requirement of Aux. Absorber Tank as per Clause 7.08.00 and Process Water Tank as per Clause 13.03.07 are to be taken care as per specification requirement.
3	VI/B	SUB-SECTION-I-M1 (FGD)	30 of 52	7.08.06	Suction screens shall be installed to protect the pump.	Suction screens are not applicable for auxiliary absorbent pump. Bidder shall provide Suction screens only inside the Absorber vessel to protect the Slurry recirculation pumps as per specification clause no. 5.06.23 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9 PART B SUB-SECTION-I-M1 (FGD).	NTPC clarified that requirement of the specification shall be considered by the bidder.
4	VI/B VI/A	SUB-SECTION-I-M1 FGD SUB-SECTION-III-A1 FGD	7.07.07 & 7.07.10 2.06.00	29 of 52 2 of 9	The complete waste water neutralization.....automated and controlled from the control room. - Adequate storage and feeding system.....contractor scope - Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level... - Automated lime feeding & dosing system for Neutralization....	Employer is requested to furnish the following: 1) A detailed scheme for automated waste water neutralization system along with automated lime feeding and dosing system since same has not been shown in the Tender Drawing no. 0011-109(2)-POM-A-003, Rev-A, Scheme of Gypsum Dewatering System. 2) Please let us know the bulk density of Hydrated lime and weather this lime (supplied by Employer) will be in the form of bags or transported through trucks. 3) As Employer is arranging the Hydrated lime unto lime storage building this point needs to be incorporated in the Terminal Point Chapter (Section-VI, Part-A, Sub-section IV, Terminal Points & Exclusions). 4) Bidder understands that the lime will be manually feed to the Bucket elevator from the lime storage room. Bidder understands that the lime bags shall be unloaded manually to the bucket elevator inlet. Employer to confirm bidder's understanding.	NTPC clarified that lime bags after unloading into a container shall be fed automatically into the bucket conveyors.
5	VI/B	SUB-SECTION-I-M1 (FGD)	8.07.00	31 of 52	For Absorber Recirculation service a Silicon Carbide impeller and SiC lining for casing can also be accepted if manufacturer has supplied a similar pump for a previous installation for similar service.	Bidder also proposes the Absorber recirculation pump impeller with Hi-chrome/ Duplex Stainless steel material and SiC lining for casing as per manufacturer's proven practice in similar applications.	NTPC clarified that Hi-chrome impeller is also acceptable as per specification requirement.
6	VI/B	SUB-SECTION-I M5	20.01.01	143 of 152	Electric Overhead Traveling (EOT) crane shall take care of erection/ maintenance requirement of pumps / blowers / machines and their associated auxiliaries for which these are being installed.	Bidder shall envisage Electric & Manual hoist as per clause 14.09.00, subsection I-M1, Vol. VI/B. Hence, EOT crane is not required & this is inline with Lot 1A/1B tenders. Bidder understands that EOT crane is applicable only for Sea water RO plant for Vallur TPP. However, EOT crane is not applicable for PT plant & ECW system.	Bidder's understanding is correct. Bidder to refer CI No-7.03.00 (ix) and 7.05.00(k) RO (2ND STAGE) SYSTEM, Sub-section-III A4, Part-A, Section-VI. Please refer CI No -7.05.00(h), Sub-section-III A4, Part-A, Section-VI for ECW system of Vallur TPP.

CLARIFICATION NO. 3 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
7	VI/E	0011-109(2)-POM-A-001	1 of 3 2 of 3 3 of 3			Bidder proposes Ceramic ball control valve in place of pinch control valve in slurry line (i.e. at Gypsum Bleed to absorber, Gypsum Bleed to primary HC, Reagent slurry to Absorber inlet as shown in tender drawing no. 0011-109(2)-POM-A-001 TECHNICAL SPECIFICATION SECTION – VI, PART-E) as per bidder's proven practice. Bidder does not have any references of pinch control valves being used in mentioned service which is not at all a good design alternative A mentioned in below reasons: - The rubber of the pinch valve is likely subject to a fast abrasion during the operation as a consequence of the high velocity in the contacted section and the rubber further reduces the area of passage. To be noted that such experience is relevant to an on/off service as well, while the control valve is permanently subject to the passage of fluid which is even worse for the material. - The actuation of a pinch valve exposes the rubber of the valve to a continuous movement that can further limit the lifetime of this component during the long term operation. Further, Ceramic ball control valve is superior to Pinch control valve. Hence employer is requested to accept bidder's proposal to use Ceramic ball control valve in this regard.	NTPC clarified that requirement of the specification shall be considered by the bidder.
8	VI/A	III-A5 (Limestone & Gypsum Handling system)	4 of 4	3.07.00	Complete ventilation system for gypsum storage shed.	As this gypsum shed is one side complete open, hence ventilation system is not required.	NTPC clarified that requirement of the specification shall be considered by the bidder.
9	VI/A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.04.00	Process Water For process water requirement, Contractor shall take a tap off suitably from the existing blow down header available near FGD area except for coastal projects (Simhadri STPP & Vallur TPP).	Bidder request customer to specify available pressure in blow down header/TP .	As already clarified, pressure available at terminal point will be furnished during detailed engineering.
10	VI/A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.05.00	Sea water PT & Desalination plant applicable for Vallur TPP: i) Contractor shall take a tap off suitably from the existing CW blow down header (To CMB) available near the proposed Sea water PT & Desalination plant (as indicated in GLP). ii) Contractor shall terminate the discharge of backwash, cleaning & chemical waste and PT plant sludge into the existing CW blow down header (To CMB) available at 200 meter downstream of intake point to sea water PT & Desalination plant	Bidder request customer to provide material of construction used in existing CW blow down header conveying sea water. Bidder request customer to specify available pressure at TP locations. Bidder request employer to provide the CWBD pipe routing drawing so that bidder can take tapping at suitable location for PT&SWRO plant inline with Terminal point chapter .	As already clarified, Material of Construction of CWBD in the mentioned project is Internally Epoxy Lined MS Pipe. Exact Routing and available Pressure at Terminal Point will be furnished during detailed engineering.
11	VI/B	SUB-SECTION-I-MS EQUIPMENT COOLING WATER SYSTEM	PAGE 19 OF 151	12.03.01.07	13. Service Lime slurry/Solution/Suspensions Recommended material Galvanized Steel	Bidder understands for limestone slurry application rubber lined carbon steel material is recommended instead of Galvanized Steel. Galvanised steel is not recommended for slurry line pipes, hence bidder has considered rubber lined carbon steel pipe , in line with lot 1A/1B tender.	NTPC clarified that requirement of the specification shall be considered by the bidder.
12	VI/A	NTECL Vallur (3 x 500 MW) GLP NTECL Vallur GLP Drg No. 0260-999- POC-F-001 Rev-05				At present Space provided behind the U#2 &3 (Between 1600N - 1800 N and 800W-1200W) is within 150m radius of existing stacks. We request Employer to provide additional area as shown in below extract of GLP so that 150m radius criteria for existing and new wet stack can be fulfilled. Bidder has not received ammended GLP for Vallur. Employer is requested to upload the same.	NTPC clarified that GLP for Vallur is not amended and requirement of the specification shall be considered by the bidder.
13	VI/A	NTECL Vallur (3 x 500 MW) GLP Drg No. 0260- 999-POC-F-001 Rev 05				Bidder envisaged that as per layout planned for FGD facilities, the foundation for duct support may rest on the existing Chimney Foundation and accordingly employer is requested to allow Bidder for it.	NTPC clarified that such layout related issues shall be discussed and suitably resolved during detailed engineering.
14	VI/A	III-A1	2 of 9	2.04.00	Provision shall be made for facilliting operation of unit with FGD bypass through existing stack. All modifications required including providing bypass dampers included in the scope of Contractor.	Bidder wish to clarify following points: - Installation of bypass damper in the existing ducting is very difficult in some of the plants based on thir site visit. - In some of the site there is no space for erection of bypass dampers. - In some plants the bypass damper support & the FGD inlet duct support (at tapping points) will come on the raft of the Stack. Bidder request employer to furnish their suggesation on the above points related to bypass damper & tapping point ducting.	NTPC clarified that such layout related issues shall be discussed and suitably resolved during detailed engineering.

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
15	VI/A	V	Page 9 of 21	4.01.05 4.01.06	The top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick Titanium/C-276 sheet over insulation.	1. Inside surface of chimney liner above roof shall be either clad steel (Titanium or C276) or borosilicate lining system as per specification. 2. External surface of chimney flue liner above chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation, for all the cases. Please Confirm.	Following shall be considered for the respective clauses: 4.01.05 For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. For Borosilicate lining, the top flue liner above the roof slab shall be made of C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner. 4.01.06 For Titanium/C-276 lining, external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. For Borosilicate lining, top portion of the flue can shall be wrapped with 8 mm thick U capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining.
16	II-A4 PROJECT INFORMATION	Table 4- Note	34 OF 37	AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI), Sr. No. 26 Annexure-XII Vallur - Sea Water Analysis	Annexure-XII Vallur - Sea Water Analysis Note: The C.W system is expected to operate at about 1.5 Cycles of concentration.	COC of 1.5 implies TDS of around 63000ppm.Due to biological /organic impurities present in cooling tower blowdown water, extensive pretreatment is required and still there will be considerable fouling in RO membranes. Also, increase in temperature of CW water will reduce the life and performance of RO membrane substantially. Change of source from cooling tower blowdown to direct sea water will help in optimum design of the system. Request employer to look into above mentioned issues and ammend the specification suitably.	NTPC clarified that requirement of the specification shall be considered by the bidder.
17				AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI), Sr. No. 4 Annexure IV: Simhadri 4 x 500 MW) GLP 3530-999-POC-F-001 Rev-06	Space near Fire station-II was allocated for FGD in Rev. 5 layout. In latest layout, this space is removed & additional space near FOPH-2 is allocated for FGD.	Considering layout optimisation, Bidder request NTPC to provide the earlier allocated space..	NTPC clarified that requirement of the specification shall be considered by the bidder.
18				AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI), Sr. No. 35 Annexure XIII: Talcher SLD ((0011-109(2)-POE-J-001/C Rev C	11 kV TIE Switchgear in FGD area (Unit#1 & 2) and 11 kV TIE Switchgear in FGD area (Unit#3, 4, 5 & 6)	Bidder wish to distribute the FGD and common system load in 11kV TIE Switchgear 1 & 2 in FGD area based on layout feasibilities. Employer to confirm.	Loads related to stage-I entirely shall be fed from 11kV tie switchgear of unit 1 and 2. Loads related to stage-II shall be fed from 11kV tie switchgear of unit 3,4,5, and 6. Scheme has been clearly indicated in tender SLD. For loads that are common for stage-I and II FGD systems, bidder may choose to feed these loads from any 11kV tie switchgear based on layout feasibilities.

CLARIFICATION NO. 3 TO TECHNICAL SPECIFICATION (SECTION-VI)

S. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	BIDDER'S QUERY	NTPC Clarification
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
19	SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	2.3 2.5(ii)	12 OF 19 13 of 19	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height.	Bidder requests employer to amend the QR criteria for Chimney design agency as mentioned below; (similar to QR criteria for chimney civil works.) (1) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with Steel/Brick Flue, of minimum 100m height. OR (2) Bidder's inhouse Engineer' team , based on their experience and approval from NTPC	NTPC clarified that requirement of the specification shall be considered by the bidder.
20	Section-VI, Part-A	Sub-Section-III-B Electrical System/Equipment	3 of 8	1.06.00	Extending AC/DC Supply from owner's existing ACDB/DCDB in switchyard area	Bidder request to employer to provide the AC/DC Supply for the followings in Switchyard area: 1. 33KV TIE Switchgear 2. 11kV TIE Switchgear (for Owner's Use) 3. Illumination of Electrical Building in Switchyard area.	AC and DC supply shall be provided BY OWNER for switchyard EHV bay equipments and its control and protection systems ONLY. Bidder shall make its own arrangement for AC and DC Auxilliary supply required for 33kV/11kV switchgear/electrical room and illumination of buildings which are under bidders scope from FGD Aux. supply system.
21	VI/A	VII	13-15 of 82	1.19.00 1.20.00 1.21.00	Mandatory Spares :- Pre-Treatment Plant Cum ECW System for Simhadri STPP-II(2X500 MW))	Bidder is unable to locate Mandatory Spares of ECW system in Cl. 1.20.00 for Simhadri Proposal whereas spares of ECW are mentioned for all other proposal against Cl. 1.19.00 & 1.21.00. Customer may please review applicability of ECW(Equipment Cooling Water System) spares for Simhadri Proposal.	NTPC clarified that requirement of the specification shall be considered by the bidder.
22	VI/B	I-M1	19 of 52	5.06.11	The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct upto absorber outlet flange) shall be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) by explosion bonding or hot rolling, having minimum 7 mm thick carbon steel as base material.	Kindly amend the clause and accept Plug Welding of C276 sheet with Carbon Steel plates of required thickness. The same will be economical and shall be deliverable in time.	NTPC clarified that requirement of the specification shall be considered by the bidder.

	TITLE: 2X250 MW BHILAI FGD SPECIFICATION FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME :
		SECTION :
		REV.NO. 00
		SHEET :

2X250 MW BHILAI **FGD SYSTEM PACKAGE**

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – D

GENERAL TECHNICAL REQUIREMENTS

(RCC CHIMNEY)

SPECIFICATION NO. PE-TS-468-620-C002

REV-00



Bharat Heavy Electricals Limited
 Project Engineering Management
 Power Sector, PPEI BUILDING, Plot No-25
 SECTOR 16A, NOIDA-201301, UP

	TITLE: 2X250 MW BHILAI FGD SPECIFICATION FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME :
		SECTION :
		REV.NO. 00
		SHEET :

PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.

	TITLE: 2X250 MW BHILAI FGD SPECIFICATION FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME :
		SECTION :
		REV.NO. 00
		SHEET :

INDEX

SECTION	DESCRIPTION

Section-C	SPECIFIC TECHNICAL REQUIREMENTS

Section-D	SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

- Sub-section D1: Earthwork in excavation and backfilling
- Sub-section D2: Cement concrete (Plain and reinforced) and formwork
- Sub-section D3: Carpentry and joinery
- Sub-section D4: Roof and underground structures water proofing, insulation and allied works
- Sub-section D5: Metal doors, windows, ventilators, louvers etc.
- Sub-section D6: Glass and glazing.
- Sub-section D7: Rolling Steel Shutter and Grills
- Sub-section D8: Miscellaneous Metal
- Sub-section D9: Masonry and allied works
- Sub-section D10: Finish to masonry and concrete
- Sub-section D11: Painting, Whitewashing, polishing
- Sub-section D12: Floor finish and allied works
- Sub-section D13: Sheet work in roof and siding
- Sub-section D14: Suspended ceiling
- Sub-section D15: Water supply, drainage & sanitation
- Sub-section D16: Road and drainage
- Sub-section D17: Fabrication of structural steelwork
- Sub-section D18: Erection of structural steelwork
- Sub-section D19: Roof decking
- Sub-section D20: False flooring
- Sub-section D21: Bored cast in situ RCC pile
- Sub-section D22: Levelling and grading

	TITLE: 2X250 MW BHILAI FGD SPECIFICATION FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-468-620-C002
		VOLUME :
		SECTION :
		REV.NO. 00
		SHEET :

Sub-section D23: Anti termite

Sub-section D24: Quality Assurance & Inspection

Sub-section D25: RCC stack

Sub-section D26: Borosilicate glass block lining system

Section-C & SECTION-D CHIMNEY ELECTRICAL AND ELEVATOR ELECTRICAL

Section-C & SECTION-D ELEVATOR MECHANICAL



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001			
VOLUME - II B			
SECTION - D		SUB-SECTION - D1	
REV.NO.	0	DATE	09/11/2020
SHEET	1	OF	22

VOLUME: II B

SECTION - D

SUB-SECTION – D1

EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-999-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 2 OF 22

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.0	SCOPE	3
2.00.00	GENERAL	3
3.00.00	EXECUTION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	19
5.00.00	RATES AND MEASUREMENTS	19
6.00.00	INFORMATION TO BE SUBMITTED BY THE BIDDER	20



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 3 OF 22

**STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN
EXCAVATION AND BACKFILLING**

1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION – D1
REV.NO. 0 DATE 09/11/2020
SHEET 4 OF 22

2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes unless specified otherwise.

IS-1200	Method of measurement of building and civil engineering works, Part-I: Earthwork
IS-2720	Method of test for soils (Relevant parts)
IS-3764	Excavation work - Code of safety
IS-4081	Safety code for blasting and related drilling operations
IS-4701	Indian Standard Code of Practice for earthwork on Canals
IS:6922	Criteria for safety and design of structures subject to underground blasts
IS: 3764	Excavation work – code of safety

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

2.4.0 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.5.0 Materials

2.5.1 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.5.2 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

2.5.3 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 5 OF 22

material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

2.6.0

Quality Control

All works shall confirm to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (c) On degree of compaction achieved

2.7.0

Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and /



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 6 OF 22

or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 7 OF 22

After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.4.0

Classification

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) **Ordinary Soil**

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) **Hard Soil**

This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) **Soft and Decomposed Rock**

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - II B

SECTION - D | SUB-SECTION - D1

REV.NO. 0 DATE 09/11/2020

SHEET 8 OF 22

- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
- iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)

This shall include :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;
- ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
- iii) boulders requiring blasting.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 9 OF 22

workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.

3.5.2

Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 10 OF 22

be excavated to the full depth unless construction is imminent. The last 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades etc, the work shall be got checked and approved by the engineer. In cases where deterioration of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

3.5.3 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

3.5.4 Blasting

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 11 OF 22

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

3.5.4.2 Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery



TITLE:
TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 12 OF 22

lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

- * not to put their feet on the clean floor unless the magazine shoes on.
- * not to touch the magazine shoes on ground outside the clean floor.
- * not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 13 OF 22

3.5.4.4

Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 14 OF 22

blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.5.5 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

- a) By using it straightway for backfilling.
- b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.
- c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 15 OF 22

a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer. All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted , redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

3.5.9 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 16 OF 22

The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 Open Timbering



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - II B

SECTION - D | SUB-SECTION - D1

REV.NO. 0 DATE 09/11/2020

SHEET 17 OF 22

In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.

3.6.0 Treatment of Slips

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

3.7.0 Backfilling

3.7.1 General

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

3.7.2 Filling and Compaction in Pits and Trenches all Around the Structures

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

3.7.3 Plinth Filling



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 18 OF 22

The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.

3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - II B

SECTION - D | SUB-SECTION - D1

REV.NO. 0 DATE 09/11/2020

SHEET 19 OF 22

should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS: 4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - II B

SECTION - D | SUB-SECTION - D1

REV.NO. 0 DATE 09/11/2020

SHEET 20 OF 22

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

e) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.2.0

Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) In case of open footings (rafts/ pilecaps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres from ground level, around excavation of 30 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

d) In case of open footings (Rafts/ pilecaps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre from ground level,



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION - D1
REV.NO. 0 DATE 09/11/2020
SHEET 21 OF 22

around excavation of 75 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

e) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

f) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

g) The authorized quantity (calculated on the basis of authorized width/working space under clause no. 5.2.0 c & 5.2.0 d) or those actually excavated, whichever, are less, shall be measured for payment.

h) Tree cutting having girth more than 300mm shall be measured in number and are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.1.0 With Tender

Detail of equipments and machineries proposed to be used for excavation, backfilling and compaction shall be submitted along with the tender.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-999-600-C001
VOLUME - II B
SECTION - D | SUB-SECTION – D1
REV.NO. 0 DATE 09/11/2020
SHEET 22 OF 22

6.2.0

After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 1 OF 56

**VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS**

SPECIFICATION NO. PE-TS-999-600-C002

SECTION – D

SUB SECTION – D2

GENERAL TECHNICAL SPECIFICATION

CEMENT CONCRETE (PLAIN & REINFORCED)



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 2 OF 56

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	INSTALLATION	12
4.00.00	SAMPLING AND TESTING	41
5.00.00	ACCEPTANCE CRITERIA	43
6.00.00	RATES AND MEASUREMENTS	43
7.00.00	LIST OF I.S.: CODES AND STANDARDS FOR REFERENCE	51



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 3 OF 56

SUB-SECTION – D2

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Prepare working drawings of formworks, scaffolds, supports, etc.
- d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Prepare detailed drawings of supports, templates, hangers, etc. required for



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 4 OF 56

installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

- i) The various ingredients of concrete
- ii) Concrete
- iii) Embedments
- iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be adopted.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 5 OF 56

- b) Type of plant and equipment proposed to be used.
- c) Names of firms with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02 After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other*waterproofing materials.
- vi) Joint filling compounds.
- vii) Foundation quality Rubber Pads.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 6 OF 56

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Bending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00

Conformity with Design

The Contractor will prepare checklists in approved Form, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 7 OF 56

Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

- a) TG foundation top deck and sub structures including raft.
- b) Spring Supporting decks of all machine foundations.
- c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.

For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 8 OF 56

Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

- a) Accelerating admixture
- b) Retarding admixture
- c) Water reducing admixture
- d) Air entraining admixture
- e) Water proofing admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 9 OF 56

of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTM C-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 10 OF 56

edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

a) Admixture:	Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete.
	For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
b) Aggregate:	Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
c) Water:	Impurities tests.
d) Cement:	Tests to satisfy relevant IS Specifications.
e) Formwork:	Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
f) Reinforcement:	Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 11 OF 56

Material tests or Certificates to satisfy relevant IS Specification.

- g) Grades of Concrete: Usage and mix design, testing of all properties.
- h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.
- i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.
- j) Embedded and Anchorage Items: Material, shape, location, setting.
- k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Bearing plates: Lines, elevations, and bedding mortar.
- n) Concrete Finishes: Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.00.00

INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 12 OF 56

cover all the aspects to the full satisfaction of the Engineer.

3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

"Design Mix Concrete" and "Nominal Mix Design" is defined as follows for use in this specification:

- a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".
- b) Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 13 OF 56

adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.
- e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS:456. All other relevant clauses of IS:456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 14 OF 56

site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

- a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.
- b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.
- c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 15 OF 56

3.07.02

Durability Requirement

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00

Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 16 OF 56

TABLE-V

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS: 1199		Use for which concrete is suitable
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide R.C.C. structures with congestion of reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00 Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space	- 12 mm
Reinforced concrete Except foundation	- 20 mm



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 17 OF 56

Ordinary Plain concrete and Reinforced
concrete foundations - 40 mm

Mass concrete - 80 mm

Lean concrete - 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.09.01 Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills) as extra payable over RCC item of BOQ:

The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.

3.09.02 Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00 Mixing of Concrete

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 18 OF 56

shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 19 OF 56

3.12.00

Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 20 OF 56

placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 21 OF 56

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 22 OF 56

placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 23 OF 56

- b) Cutting away the defective concrete to the required depth shape.
- c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortars.
- k) Polymer modified patching and adhesive repair & mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes,



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 24 OF 56

ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 25 OF 56

acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 26 OF 56

other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 Welding / Coupler for Splicing

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 27 OF 56

Welding of High yield strength deformed bar shall not be allowed.

Splicing of reinforcement using mechanical coupler may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian standards for "Reinforcement couplers for mechanical splices of bars in concrete" as per IS: 16172. Corrosion test in the coupler-bar connections exposed to marine or severe environmental conditions to rule out any risk of galvanic corrosion will be done by the contractor at no extra cost. Proper fitting & fixing of mechanical coupler to rebar shall be ensured at site for each coupled joint as per inspection testing plan developed at site in consultation with manufacturer of coupler. If so required at site, coupler/ threading on rebar shall be such that two bars can be coupled by moving couplers not rebar (as being heavy reinforcement weight and L shaped, it is not feasible to rotate the rebar for fixing up the coupler) at no extra cost.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 28 OF 56

contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 29 OF 56

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 30 OF 56

3.20.04

Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05

Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06

Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

- For -
- a) Sectional dimension - ± 5 mm
 - b) Plumb - 1 in 1000 of height
 - c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface & should not be taken as tolerances for the entire structure



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 31 OF 56

taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

- a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.
- c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 32 OF 56

to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

- a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of other contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 33 OF 56

laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 34 OF 56

the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 35 OF 56

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 36 OF 56

Maximum Safe Continuous
Temperature : 70 Deg.C

Ultimate Elongation : Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 37 OF 56

3.25.00

Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00

Waterproofing of Concrete Structure

3.26.01

General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 38 OF 56

Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02

Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 39 OF 56

Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03

Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasticizer will be preferable.

- a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.
- b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04

Structural waterproofing

- a) Nozzles spaced as required after the concrete is completed shall be drilled



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 40 OF 56

into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 41 OF 56

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.
- ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,
- v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250-micron polyethylene film as second layer similar to (iii)above.
- viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 42 OF 56

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 43 OF 56

and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 44 OF 56

strength.

If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

- a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.
- b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.
- c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.
- d) The unit rates shall include all arrangement for maintaining stability of structure during execution.
- e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.
- f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 45 OF 56

payable to the contractor as per BOQ item.

- g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.
- h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02 Measurements

- a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres to the nearest two decimals.
- b) No deductions shall be made for the following:
 - i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;
 - ii) Opening upto 0.1 sq.m.
 - iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.
 - iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.
- c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.
- d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 23°C.

6.02.00 Reinforcement

6.02.01 Rates

- a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 46 OF 56

- b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.
- c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made. Similarly, splicing of reinforcement bars using mechanical couplers if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made.
- d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).
- e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

- a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.
- b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

- a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 47 OF 56

- b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.
- c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.
- d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.
- e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.
- f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements

- a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.
- b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

- d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.
- e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.
- e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

- a) The unit rate for erection of embedded steel parts, supplied by Engineer



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 48 OF 56

shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

- b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.
- c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

- a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.
- b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.
- c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.
- d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.
- e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.
- f) The expansion fasteners shall be measured in number according to tension capacity.
- g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 49 OF 56

- a) Measurement shall be in cubic decimeters.
- b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.
- c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.
- d) No deduction shall be made for shims, bolts, shear keys and such other embedments.
- f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightness shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

- a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

- b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

- c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 50 OF 56

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

6.07.02 Measurements

- a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be done on the same basis as that applied for construction work.
- b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).
- c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 51 OF 56

- a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.

7.00.00 LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

- IS: 73 - Indian Standard Specification for Paving Bitumen
- IS: 216 - Indian Standard Specification for Coal Tar Pitch
- IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement
- IS: 455 - Indian Standard Specification for Slag Cement
- IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 52 OF 56

Structures

- IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS: 702 - Indian Standard specification for industrial bitumen.
- IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement
- IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.
- IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
- IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks
- IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 53 OF 56

- IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS: 2571 - Code of practice for laying in-situ cement concrete floors.
- IS: 2645 - Integral cement water proofing compound
- IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batches for Concrete (Single and Double Bucket type)
- IS: 2750 - Indian Standard Specification for steel scaffoldings.
- IS: 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
- IS: 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete
- IS: 3025 - Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry
- IS: 3067 - Code of practice for general design details and preparatory work for damp proofing and water proofing of building.
- IS: 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses
- IS: 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids
- IS: 3414 - Code of practice for design and installation of joints in buildings.
- IS: 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
- IS: 3558 - Code of Practice for use of Immersion vibrators for Consolidating Concrete
- IS: 3696 - Safety Code for Scaffolding and Ladders
- IS: 3812 - Indian Standard Specification for Fly Ash for Use as Admixture for Concrete
- IS: 4014 - Code of practice for steel tubular scaffolding.
- IS: 4031 - Indian Standard Specification for Method of Tests for



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 54 OF 56

Hydraulic Cement

- IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site
- IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches
- IS: 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes
- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS: 4926 - Indian Standard Specification for Ready Mixed Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground
- IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials
- IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.
- IS: 5256 - Code of practice for sealing joints in concrete lining on canals.
- IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials
- IS: 5513 - Indian Standard Specification for vacate Apparatus.
- IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.
- IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
- IS: 5624 - Indian Standard Specification for foundation bolts.
- IS: 5751 - Indian Standard Specification for Precast Concrete Coping



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 55 OF 56

Blocks.

- IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.
- IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.
- IS: 5892 - Indian Standard Specification for transit mixer and agitators.
- IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS: 6909 - Indian Standard Specification for Super sulphated Cement
- IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
- IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
- IS: 7242 - Indian Standard Specification for Concrete Spreaders.
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.
- IS: 7251 - Indian Standard Specification for Concrete Finishers.
- IS: 7293 - Safety code for working with construction machinery.
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.
- IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.
- IS: 7969 - Safety Code for Storage and Handling of Building Materials.
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.
- IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.
- IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

VOLUME - II B

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE : 30/11/2015

SHEET 56 OF 56

- IS: 8989 - Safety Code for Erection of Concrete Framed Structures.
- IS: 9012 - Recommended method for shotcreting.
- IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.
- IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS: 10262 - Recommended Guidelines for Concrete Mix Design.
- IS: 13311 - Non-destructive testing of concrete.
- SP: 34 - Handbook of concrete, reinforcement and detailing.



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
JOINERY**

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 1 OF 7

VOLUME: II B

SECTION - D

SUB-SECTION – D3

CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
JOINERY**

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 2 OF 7

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	6
5.00.00	RATES AND MEASUREMENTS	6



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 3 OF 7

CARPENTRY AND JOINERY

1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

2.00.00 INSTALLATION

2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number of joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is BWP grade phenol formaldehyde synthetic resin conforming to IS: 848. The thickness shall be as specified.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 4 OF 7

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 5 OF 7

2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Paneling, Pelmet, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 6 OF 7

3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848 - Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)

IS: 1003 - Timber panelled and glazed shutters.

IS: 2191 - Wooden flush door shutter (Cellular and hollow core type).

IS: 2202 - Wooden flush door shutters (solid core type).

IS: 4021 - Timber door, window, and ventilator frames.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall include of all activities mentioned in "Schedule of Item" for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges,



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

VOLUME - II B

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE : 30/11/2015

SHEET 7 OF 7

holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 1 OF 15

VOLUME: II B

SECTION – D

SUB-SECTION – D4

**ROOF AND UNDERGROUND STRUCTURES WATER
PROOFING, INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 2 OF 15

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE	13
4.00.00	I.S. CODES AND STANDARDS	14
5.00.00	RATES AND MEASUREMENTS	15



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 3 OF 15

**ROOF AND UNDERGROUND WATER PROOFING,
INSULATION AND ALLIED WORKS**

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 4 OF 15

by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expanded Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 5 OF 15

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturers supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

2.04.00 Waterproofing Treatment

2.04.01 Bitumen Felt Treatment

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 6 OF 15

Normal treatment with one layer of felt, heavy treatment with two layers of felt or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:

a) Normal Treatment - Five courses

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Hessian base self-finished felt, type 3, grade I.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fibre base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 7 OF 15

- 3) Fibre base self-finished felt, type 2, grade 2.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Fibre base self-finished felt, type 2, grade 2.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fibre based felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 3) Fibre-base self-finished felt type 2, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)
- 5) Fibre base self-finished felt type 2, grade 1.
- 6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 7) Fibre base self-finished felt type 2, grade 1.
- 8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 3) Hessian base self-finished felt, type 3, grade 1.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 8 OF 15

- 4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 5) Hessian base self-finished felt, type 3, grade 1.
- 6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.
- 7) Hessian base self-finished felt, type 3, grade 1.
- 8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.
- 9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

2.04.02

Elastomeric Membrane

a) Material

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTM C 836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of 70°C minimum, 300%



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 9 OF 15

elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkali and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane is applied.

c) Finishing coats:

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish:

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using 12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 10 OF 15

and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.

2.04.03 Waterproofing by Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

a) 2 layers - for depths up to 5m below ground level

b) 3 layers - for depths beyond 5m below ground level

2.05.01

Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose, drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

- i) Primer (For vertical faces only), as per I.S. 3384.
- ii) Hot applied blown bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base, bitumen felt type 3 grades 2
- iv) Hot applied blown bitumen @ 1.2 Kg/m²
- v) Hessian base, bitumen felt type 3 grade 2
- vi) Hot applied blown bitumen @ 1.2 Kg/m²

B) Extra Heavy treatment (Three layers of felt)

- i) Primer (for vertical faces only) as per I.S. 3384



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 12 OF 15

- ii) Hot applied bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base bitumen felt type 3 grades 2
- iv) Hot applied bitumen at the rate 1.2 Kg/m²
- v) Hessian base bitumen felt type 3 grades 2
- vi) Hot applied bitumen at the rate of 1.2 Kg/m²
- vii) Hessian base bitumen felt type 3 grades 2
- viii) Hot applied bitumen at the rate of 1.2 Kg/m²

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Point for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 13 OF 15

3.00.00

ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship as under:

For Bitumen Felt Treatment under clause no. 2.04.01: 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment.

For Elastomeric Membrane under clause no. 2.04.02: 10 (ten) years.

In case guarantee is more stringent in owner specification, more stringent guarantee shall be applicable. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.



TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 14 OF 15

4.00.00

I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- a) IS: 73 - Paving Bitumen
- b) IS: 702 - Industrial Bitumen
- c) IS: 1203 - Methods of testing tar and bitumen
- d) IS: 1322 - Bitumen felts for waterproofing and damp proofing.
- e) IS: 1346 - Code of practice for waterproofing of roofs with bitumen felts.
- f) IS: 1609 - Damp-proofing Treatment using Bitumen Felts – Code of Practice
- g) IS: 3067 - Code of practice for General design details and preparatory work for Damp-proofing and water-proofing of buildings
- h) IS: 3384 - Bitumen primer for use in waterproofing and damp proofing.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

VOLUME - II B

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 03/10/2017

SHEET 15 OF 15

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labor, as detailed in the specification unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00 Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005		
VOLUME - II B		
SECTION - D	SUB-SECTION – D5	
REV.NO. 00	DATE 03/10/2017	
SHEET 1	OF	15

VOLUME: II B

SECTION - D

SUB-SECTION – D5

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-999-600-C005



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005
VOLUME - II B
SECTION - D | SUB-SECTION – D5
REV.NO. 00 DATE 03/10/2017
SHEET 2 OF 15

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	8
4.00.00	INFORMATION TO BE SUBMITTED	9
5.00.00	I.S. CODES	10
6.00.00	RATES AND MEASUREMENTS	10

ATTACHMENT

ANNEXURE – A	SCHEDULE OF FIXTURES	12



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 15

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS: 1081 or as approved by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 15

2.02.00 Fabrication

2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardware's where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 15

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) "Double Plate Flush Door Shutters."

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18-gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Jindal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 15

2.02.02

Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15-micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00

Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00

Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 15

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00

Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper "Lines and levels", and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one meters from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 15

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in IS:3614 (Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open outside.

All necessary accessories and hardware shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION – D5

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 15

k) Shop coats shall be properly applied.

l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.

3.02.00 For installed Items

- a) Installations shall be at correct location, elevation and in general, on a true vertical plane.
- b) Fixing details shall be strictly as shown on drawings.
- c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.
- d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- e) All openable section shall operate smoothly without jamming.
- f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.
- g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

4.00.00 INFORMATION TO BE SUBMITTED

4.01.00 With Tender

- a) Names of manufacturers for Doors, windows etc.
- b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.02.00 After Award

- a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION – D5

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 15

- b) He shall submit a programme of work to be done for the approval of the Engineer.
- c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.

5.00.00

IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose)	-	IS: 1285
Steel doors, windows, and ventilators	-	IS: 1038
Steel windows for industrial, building	-	IS: 1361
Aluminium doors windows, and ventilators	-	IS: 1948
Aluminium windows for industrial buildings	-	IS: 1949
Steel doorframes	-	IS: 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 15

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per "Schedule of Items".

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or aluminum shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminum partition frames shall be in Kg. Paneling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in Sqm in net area outer to outer of the door.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 15

ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

- i) 100 mm brass butt hinges with screws - 3 Nos.
- ii) 150 mm brass tower bolts with screws - 1 No.
- iii) 100 mm x 225 mm clear plastic push
Plate with counter sunk brass screws - 1 No.
- iv) 30 mm brass ring pull handle with
Plates and screws - 1 No.
- v) 150 mm brass coat hook with screws - 1 No.

vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see "Door Schedule".

B. ALUMINIUM DOORS

1. For double leaf door

- i) Concealed hanging arrangement for door leaves.
- ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.
- iii) Heavy duty, cylinder look on active leaf.
- iv) Pull handle of approved design on both leaves.
- v) Doors stops for both leaves.
- vi) Overhead door closure for both leaves.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 15

ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

- i) 100 mm butt hinges - 3 Nos. on each leaf.
- ii) 300 mm aluminum tower bolt - 2 Nos. (top and bottom)
On inside of inactive
Leaf. 1. No. (Top only)
On inside active leaf.
- iii) 200 mm anodized aluminum
pull handle - 1 No. of each leaf.
- iv) Door stop of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

- i) 100 mm butt hinges - 3 Nos.
- ii) 300 mm aluminum tower bolt - 2 Nos. top & bottom of Inside
face
- iii) 200mm anodised aluminum
Pull handle - 1 No.
- iv) Door stop of approved design - 1 No.

NOTE: For locks, door closures and threshold, see "Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

- i) Hinges - As per standard Practice of the
Manufacturer, but minimum two
hinges Per leaf.
- ii) 12" peg stays - 1 No. per leaf



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION – D5

REV.NO. 00 DATE 03/10/2017

SHEET 14 OF 15

ANNEXURE-A

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication
assembles - 2 Nos. per leaf.

iii) 2 point handles - 1 No. per leaf.

c) Bottom Hung Ventilators (Projecting in)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for
opening adjustment. - 2 Nos. per leaf.

iii) Spring Catch - 1 No. per leaf.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-999-600-C005

VOLUME - II B

SECTION - D | SUB-SECTION – D5

REV.NO. 00 DATE 03/10/2017

SHEET 15 OF 15

ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per IS-1948 latest editions)

a) Side Hung Windows

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) 300 mm peg stays - 1 No per leaf
- iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf
- iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Concealed side arms for opening adjustment - 2 Nos. per leaf
- iii) Spring Catch - 1 No. per leaf



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

SECTION - D SUB-SECTION – D6

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 5

VOLUME: II B

SECTION - D

SUB-SECTION – D6

GLASS AND GLAZING

SPECIFICATION NO. PE-TS-999-600-C006



Bharat Heavy Electricals Limited

Project Engineering Management

PPEI Building, Power Sector,

Plot No. 25, Sector 16A,

Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

SECTION - D SUB-SECTION – D6

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 5

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	4
4.00.00	I.S. CODES	4
5.00.00	RATES	5



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

SECTION - D SUB-SECTION - D6

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 5

GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials:

- a) Glare reducing or heat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.
- c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.
- d) Obscure glasses shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.
- g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

SECTION - D SUB-SECTION - D6

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 5

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00 ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

SECTION - D SUB-SECTION – D6

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 5

4.00.00 I.S. CODES

Following are some of the important I.S. Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.

5.00.00 RATES

Rates of glass and glazing if not included in respective items for supply and installation of window, ventilator, and partitions shall be paid separately as per BOQ items provided. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-999-600-C007

VOLUME - II B

SECTION - D

SUB-SECTION – D7

REV.NO. 00

DATE 03/10/2017

SHEET 1

OF 5

VOLUME: II B

SECTION - D

SUB-SECTION – D7

ROLLING STEEL SHUTTERS AND GRILLS

SPECIFICATION NO. PE-TS-999-600-C007



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-999-600-C007

VOLUME - II B

SECTION - D

SUB-SECTION - D7

REV.NO. 00

DATE 03/10/2017

SHEET

2

OF

5

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA & GUARANTEE	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	5



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-999-600-C007

VOLUME - II B

SECTION - D SUB-SECTION - D7

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 5

ROLLING STEEL SHUTTERS AND GRILLS

1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

- a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 1.25 mm thick for shutters having width more than 4.5 M, wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.
- b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia. rods.
- c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.
- d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.
- e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.
- f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- g) Hoods shall be formed of not less than 20-gauge steel, suitable reinforced to prevent sag.
- h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-999-600-C007

VOLUME - II B

SECTION - D SUB-SECTION - D7

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 5

- i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

- j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.
- k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Power operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

2.05.00 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-600-C007			
	TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS AND GRILLS	VOLUME - II B			
		SECTION - D		SUB-SECTION – D7	
		REV.NO.	00	DATE	03/10/2017
		SHEET	5	OF	5
and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.					
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE				
3.01.00	Shop Inspection				
After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.					
3.02.00	Field Inspection				
After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.					
3.03.00	Guarantee				
The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.					
4.00.00	I.S. CODE				
IS: 6248 - Metal rolling shutters and rolling grills.					
5.00.00	RATES AND MEASUREMENT				
5.01.00	Rates				
Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.					
5.02.00	Measurement				
Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.					



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 9

VOLUME: II B

SECTION - D

SUB-SECTION – D8

MISCELLANEOUS METAL

SPECIFICATION NO. PE-TS-999-600-C008



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 9

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	7
4.00.00	IS CODES	8
5.00.00	RATES AND MEASUREMENTS	8



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 9

MISCELLANEOUS METAL

1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION

2.01.00 Fabrication/casting

2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.01.02 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with IS: 816.
- c) Welding of aluminium shall be done accordance with IS: 2812, "Arc welding of Aluminium and Alloys." Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill scale, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 9

2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, then those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.



TITLE:
**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING**

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 9

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. light duty for carrying tensile load upto 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer's instructions and as approved by the Engineer.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

- a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
- b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 9

- c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.
- d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consist of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.
- e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more than ± 0.05 mm. all steel wire shall be hot dipped galvanised wire. The Dia. shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. mild steel. The stirrup wires for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 9

steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:

Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

2.03.02

Barbed Wire Fencing

The barbed wire shall be conforming to IS:278 latest editions. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two-line wire and two-point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one-line wire (Type A - around both line wire, Type B - around one-line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The distance between two barbs shall be 75±12mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 9

evenly spaced row of line wire in all. The top line wire shall be doubled, making five-line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

- a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be as follows
 - i) Permissible deviation from, straightness – 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blowholes, cracks, and other blemishes.
- d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

IS:278	Specification for Galvanized Steel Barbed wire for fencing.
IS:816	Code of practice for use of Metal Arc welding for general construction in mild steel.
IS:1367	Industrial Fasteners – Threaded steel fasteners - Technical supply condition.
IS:2721	Specification for Galvanized Steel Chain Link fence fabric.
IS:2812	Arc welding of Aluminum and Alloy



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-999-600-C008

VOLUME - II B

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 9

5.00.00 RATES AND MEASUREMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.

Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.



**TECHNICAL SPECIFICATION FOR
MASONRY AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 1 OF 12

VOLUME: II B

SECTION - D

SUB-SECTION – D9

MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 2 OF 12

C O N T E N T

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	6
4.00.00	I.S. CODES	10
5.00.00	RATES AND MEASUREMENTS	11



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 3 OF 12

MASONRY AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours' immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded; to minimize breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky, or earthly appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours'



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 4 OF 12

immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS: 383 and shall be such as to produce a dense concrete or the specified proportions and strength and of consistence that will work readily into position without segregation.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 5 OF 12

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.

Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc.

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 6 OF 12

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by especially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days' work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborundum stone shall be used for rubbing down.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 8 OF 12

3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by especially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 9 OF 12

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days' work top surface of masonry shall be kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double Chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 10 OF 12

Where shown on drawing, damp proof membrane with one-layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.06.00

Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly over burnt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other pattern as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 11 OF 12

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00

I.S. CODES

Some of the important relevant codes for this section are:

IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.

IS: 1597: Code of Practice for Construction of stone Masonry.

IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.

IS: 2212: Code of Practice for Brickwork.

IS: 2250: Code of Practice for preparation and use of masonry Mortar.

IS: 5134: Bitumen Impregnated Paper & Board.

5.00.00

RATES AND MEASUREMENTS

5.01.00

Rates

Unit rate for masonry work shall include the following:

- Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.
- Preparing top sand sides of existing wall for joining old with new work.
- Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009

VOLUME - II B

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 03/10/2017

SHEET 12 OF 12

5.02.00

Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

- a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.
- b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.
- c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.
- d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 sqm in section;
- e) Chases of section not exceeding 50 cm in girth;
- f) Iron fixtures, such as wall ties and hold fasts for doors and windows;
- g) Cement concrete blocks as for hold fasts and holding down bolts;
- h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.



**TECHNICAL SPECIFICATION FOR
FINISH TO MASONRY AND CONCRETE**

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 1 OF 9

VOLUME: II B

SECTION - D

SUB-SECTION – D10

FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 2 OF 9

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	8
4.00.00	I.S. CODE	8
5.00.0	RATES AND MEASUREMENTS	9



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 3 OF 9

FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items, the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 4 OF 9

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.

For sand cement plaster, sand and cement in the specified proportion shall be

mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.02.03 Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1-part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 6 OF 9

Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1-part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 7 OF 9

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1-part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1-part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 8 OF 9

lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1-part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010

VOLUME - II B

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 03/10/2017

SHEET 9 OF 9

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall be measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 13

VOLUME: II B

SECTION - D

SUB-SECTION – D11

PAINTING, WHITEWASHING, POLISHING

SPECIFICATION NO. PE-TS-999-600-C011



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 13

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND TESTING	10
4.00.00	I.S. CODES AND STANDARDS	11
5.00.00	RATES AND MEASUREMENTS	12



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 13

PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of Paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 13

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and shall conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 13

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not be yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well-known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pre-treated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02

Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00

Preparation of surface

Before starting the work, the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 13

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477 (Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc. and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrapers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 13

2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 13

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1-part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers, the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.



TITLE:
**TECHNICAL SPECIFICATION FOR
 PAINTING, WHITEWASHING,
 POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 13

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conforming to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primed surface. Sub sequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flattening varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 13

hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 13

3.00.00

ACCEPTANCE CRITERIA AND TESTING

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surfaces shall be of uniform texture and high glossy finish.
- c) The colour, texture etc. shall match exactly with those of approved samples.
- d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.



TITLE:
TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 13

Testing

- a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.
- b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.
- c) Material/workmanship unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00

I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348 Specification for French polish

IS: 427 Specification for Distemper, dry colour as required.

IS: 428 Specification for Distemper oil emulsion, colour as required.

IS: 1477 Code of Practice for painting of ferrous metal in buildings.
(I & II)



TITLE:
**TECHNICAL SPECIFICATION FOR
 PAINTING, WHITEWASHING,
 POLISHING**

SPECIFICATION NO. PE-TS-999-600-C011

VOLUME - II B

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 13

IS: 2338 Code of Practice for finishing of wood and
(I & II) wood based materials.

IS: 2339 Specification for Aluminium, Paints for general purposes in
dual containers.

IS: 2395 Code of Practice for painting concrete, masonry, and Plaster
surface.

IS: 2932 Specification for enamel, exterior type-1.

IS: 5410 Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the “Schedule of
Items”.

Rate shall include cleaning, preparation of surface, supply and application of
primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on
the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of
beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill
of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not
exceeding 3.0 Sqm each and no addition shall be made for reveals, jams,
soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for
opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be
increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel
(as per section D-17 clause 6.02.00 i.e. Mode of measurement of technical
specification for fabrication of structural steel works) unless specified
otherwise.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 22

VOLUME: II B

SECTION - D

SUB-SECTION – D12

FLOOR FINISH AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C012



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 22

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	4
3.00.00	ACCEPTANCE CRITERIA	20
4.00.00	I.S. CODES	21
5.00.00	RATES AND MEASUREMENTS	21



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 22

FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

- i) Integral finish to concrete base
- ii) Terrazzo finish
- iii) Granolithic finishes
- iv) Patent Stone
- v) Metallic Hardener like “Ironte”/Hardonate Finish
- vi) Mastic Asphalt finishes
- vii) Chemical Resistant finish

b) Tiled Finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Tesse rae (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab including Kota Stone.

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FLOOR FINISH AND ALLIED WORKS	SPECIFICATION NO. PE-TS-999-600-C012
		VOLUME - II B
		SECTION - D SUB-SECTION – D12
		REV.NO. 00 DATE 03/10/2017
		SHEET 4 OF 22
1.01.00	Base The base to receive the finish is covered under other relevant specifications.	
1.01.01	Sequence Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view of the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.	
2.00.00	INSTALLATION	
2.00.01	Special Materials Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise. The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.	
2.00.02	Workmanship Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.	
2.00.03	Preparation of the Base Surface The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work. For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and	



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 22

detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as per the acceptability of the surface.

2.01.00 In Situ Finishes

2.01.01 Integral Finish to Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq.M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.01.02 Terrazzo Finish in Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to achieve the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 22

b) Mix**i) Underbed**

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1-part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1-part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Sieve No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat “green” but firm enough to receive the



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 22

topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine cannot be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03

Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 22

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1-part cement, 1-part coarse sand, 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary, the surface of the base shall be roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to heavy traffic during this period.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 22

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

2.01.04 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1-part cement and 2-part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 22

a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.01.05 Metallic Hardener Like ‘Ironite’/`Hardonate’ Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is `green`.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1-part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification ‘Cement Concrete’ and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 22

The finish shall be laid while the concrete underbed is still very 'green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothed with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 22

quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 22

thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) **Mix: Underbed**

The underbed for floor and similar horizontal surfaces shall be 1-part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1-part cement and 3 parts coarse sand by weight.

d) **Laying**

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 14 OF 22

joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed

As per clause 2.02.01 (c).



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 15 OF 22

- d) Laying
As per clause 2.02.01 (d).

- e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

2.02.03 Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

- a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

- b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawling, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 16 OF 22

c) Mix: Underbed

The mix for the underbed shall consist of 1-part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

c) Laying

Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04 Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed

Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 03/10/2017

SHEET 17 OF 22

mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

2.02.05 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm². The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 18 OF 22

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1-part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 19 OF 22

joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished with an approved type of polish just before handing over.

2.02.07 Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed

Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 20 OF 22

stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall

be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally, clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form an inverted 'Y'.

3.00.00 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture

	TITLE: TECHNICAL SPECIFICATION FOR FLOOR FINISH AND ALLIED WORKS	SPECIFICATION NO. PE-TS-999-600-C012 VOLUME - II B SECTION - D SUB-SECTION – D12 REV.NO. 00 DATE 03/10/2017 SHEET 21 OF 22
	e) Surface finish f) Thickness of joints g) Details at edges, junctions etc. h) Performance i) Precautions specified for durability 4.00.00 IS. CODES All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 777 : Glazed earthenware tiles IS: 1196 : Code of practice for laying bitumen mastic flooring. IS: 1197 : Code of practice for laying of rubber floors IS: 1237 : 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. IS: 3461 : PVC asbestos floor tiles IS: 4860 : Specification for acid resistant bricks IS: 5518 : Code of practice for laying of flexible PVC Sheet and tile flooring. IS: 5491 : Code of practice for laying in situ granolithic floor topping.	



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 03/10/2017

SHEET 22 OF 22

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for the complete work (including dividing strips, Ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.

Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.

5.02.00 Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION – D13

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-999-600-C013



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION – D13

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	6



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION – D13

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 6

SHEET WORK IN ROOF AND SIDING

1.00.00 SCOPE

This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified.

2.00.00 INSTALLATION

2.01.00 Storage of Materials

All materials shall be stored by the Contractor in proper way to prevent all damage.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527.

2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stitching ridge cappings, corner pieces, ventilators, north light curves etc.

2.02.02 C.G.I. Sheeting and Aluminium Sheeting

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.

**TITLE:****TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION - D13

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 6

2.02.03 Fibre Glass Reinforced Plastic Sheeting

This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.

**2.02.04 PERMANENT COLOUR COATED (SANDWICHED INSULATED)
METAL CLADDING SYSTEM**

- i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF₂) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.
- ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm.
- iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.
- iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap.
- v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cum. for glass wool & 48 Kg/cum. for rock wool.

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C013
	TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	VOLUME - II B
		SECTION - D SUB-SECTION – D13
		REV.NO. 00 DATE 03/10/2017
		SHEET 5 OF 6

2.02.05

PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM

i.

Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF₂ paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability.

ii.

FLASHING, CAPS, TRIM CLOSURES ETC.

All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

3.00.00

ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a)

Side and end laps

b)

Absence of cracks, holes or damages in sheet

c)

Spacing of bolts

d)

Provision of double washers (G.I. and asbestos or bituminous washers)

e)

Proper installation of flashing.

4.00.00

I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 3007

:

Code of practice for laying of asbestos cement sheets.

IS: 2527

:

Code of practice for fixing rainwater gutters and down pipes for roof drainage.

	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-999-600-C013 VOLUME - II B SECTION - D SUB-SECTION – D13 REV.NO. 00 DATE 03/10/2017 SHEET 6 OF 6
	IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings. IS: 277 : Specification for galvanized steel sheets (plain and corrugated). 5.00.00 RATES AND MEASUREMENT 5.01.00 Rates Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage. 5.02.00 Measurement Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.	



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	SAMPLES	5
4.00.00	SHOP DRAWINGS	5
5.00.00	ACCEPTANCE CRITERIA	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 6

SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels,



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 6

unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the “Schedule of items”. The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

- a) Plaster of Paris board (decorative)
- b) Expanded polystyrene insulation board with plastic fascia.
- c) Fibre Insulation board.
- d) Bonded wooden particle board (Plain and decorative)
- e) Glass fibre reinforced polystyrene sheets.
- f) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer’s instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling system shall be “Luxalon 84C” or approved equal and the installation shall be strictly as per manufacturer’s instruction/ specification subject to approval of the Engineer.

**TITLE:****TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 6

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia. galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length: each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-ordinated with all related work and shall show the following information:

- a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- b) Typical Intermediate framing for support where required.
- c) Hanger fastening details.
- d) Panels - unit support at ceiling penetrations.
- e) Details of splicing method for main and cross runners.
- f) A table indicating load bearing capacity of main and cross runner
- g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 6

5.00.00 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cut-outs for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.

6.02.00 Measurement

Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 23

VOLUME: II B

SECTION - D

SUB-SECTION – D15

**WATER SUPPLY, DRAINAGE
AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 23

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIAL	3
3.00.00	INSTALLATION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	17
5.00.00	I.S. CODES	20
6.00.00	RATE AND MEASUREMENT	21



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 23

WATER SUPPLY, DRAINAGE AND SANITATION

1.00.00 SCOPE

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade conforming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 23

For Roof drainage and building sanitation works following type of pipe are coved in this Section:

- a) Cast Iron pipe
- b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized)
- c) Concrete pipe
- d) Asbestos cement pipe
- e) PVC pipe
- f) Stoneware pipe
- g) Vitrified pipe
- h) Lead pipe (not to be used for portable water)

2.02.01

Fixtures

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish.

Unless specified in the contract the fixtures shall be as specified hereinafter.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 23

Water closet

a) European type

It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) Squatting type

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

Urinals

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

Wash Basin

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

Sink

It shall be made of glazed vitreous china conforming to IS:2556, Part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 23

Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.

Glass shelves

Glass shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated.

Towel rail

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

Soap holder

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws.

Liquid Soap Dispenser

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated.

Valve, cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified.

2.03.00

Water Storage Tank

Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 23

3.00.00 INSTALLATION

3.01.00 General

Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

3.02.00 Portable water supply Pipe Lines

3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 23

3.02.03 Contamination

There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

3.02.04 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

3.02.05 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.

3.02.06 Jointing of Pipes

All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.

3.02.07 Painting

Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 23

3.03.00 RAINWATER DOWN COMERS

3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

3.03.02 Khurras

The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade.

3.03.03 Gutters

The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 23

have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

3.04.00 SOIL AND DRAINAGE PIPES

3.04.01 Gradients

If not specified, the minimum gradients of soil and drainage pipeline shall be as follows:

100 mm nominal dia.	:	1 in 35
150 mm nominal dia.	:	1 in 65
230 mm nominal dia.	:	1 in 120
300 mm nominal dia.	:	1 in 200

3.04.02 Relation with water supply pipelines

Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

3.04.03 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 23

done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows:

- a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.
- b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.
- c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.
- d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

3.04.05

Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 23

3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

3.04.07 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-siphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 23

3.04.10

Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 14 OF 23

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement: 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 15 OF 23

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earth ware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 16 OF 23

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.

3.04.12 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

3.05.00 WATER STORAGE TANKS

Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leak-proof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL

3.06.01 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 17 OF 23

pipe of at least 100 m dia. whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

3.06.02 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

3.06.03 Soak pit

The soak pit shall be complete. It shall consist of a 900 mm dia. pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

3.06.04 Open jointed SW Pipe/dispersion trenches

Minimum dia. of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench.

3.06.05 Commissioning septic tank

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge, a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.07.00 Related Works

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 18 OF 23

3.08.00 Regulation

The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Inspection Before installation

All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

4.02.00 Testing of Water Supply pipe line

4.02.01 Testing of Mains After Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

4.02.02 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 19 OF 23

4.03.00

Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 03/10/2017

SHEET 20 OF 23

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) For straightness

- i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe end emerge at the lower end; and
- ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

4.04.00 Fittings and Fixtures etc.

All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable.

4.05.00 Testing Septic Tank

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs.

5.00.00 I.S. CODES

Important relevant IS Codes for this specification are listed below:

Latest editions shall always be consulted.

IS: 404	:	Lead pipes.
IS: 407	:	Brass tubes for general purposes.
IS: 458	:	Concrete pipes (with or without reinforcement)
IS: 783	:	Code of Practice for laying of concrete pipes.
IS: 1172	:	Code of basic requirements for water supply, drainage and sanitation.
IS: 1200 (Pt. XVI)	:	Laying of water and sewer lines, including appurtenant items.

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 03/10/2017 SHEET 21 OF 23
	IS: 1230 : Cast iron rain water pipes and fittings. IS: 1239 : Specification for Mild Steel Tubes and Mild Steel (Pt. I & III) Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter). IS: 1536 : Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage. IS: 1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage. IS: 1592 : Asbestos cement pressure pipes, IS: 1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). IS: 2065 : Code of Practice for Water Supply in buildings. IS: 2501 : Copper tubes for general engineering purposes. IS: 2556 : Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement IS: 2633 : Method of testing, uniformity of coating on zinc coated articles. IS: 3076 : Low density polyethylene pipes for portable water supplies. IS: 3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). IS: 3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). IS: 4827 : Specification for electro plated coatings of nickel and chromium on copper and copper alloy. IS: 4964 : High-density polyethylene pipes for portable water supplies. IS: 12701 : Rotational moulded polyethylene water storage tanks	

	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 03/10/2017 SHEET 22 OF 23
6.00.00	RATE AND MEASUREMENT	
6.01.00	RATE	
6.01.01	G.I. Pipes for Water Supply	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.	
6.01.02	Rainwater Down-comers	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also includes cost of jointing and making good the opening in structure.	
6.01.03	Sanitary Fixtures	
	Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes.	
6.01.04	Drainage and Sewer Pipes	
	Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc.	
6.01.05	Floor and Gully Traps	
	Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”.	
6.01.06	Manholes, Septic Tank, Soak Pit and Cover	
	Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item.	
6.01.07	Water Storage Tank	
	The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete.	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 03/10/2017

SHEET 23 OF 23

6.02.00 MEASUREMENTS

6.02.01 Pipe for Water Supply and Drainage

For G.I. Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials.

The pipe shall be measured separately according to dia. and class of pipe.

Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.

6.02.02 Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in “Schedule of Items”.

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in “Schedule of Items”.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 36

VOLUME: II B

SECTION - D

SUB-SECTION – D16

SPECIFICATION NO. PE-TS-999-600-C016

ROAD AND DRAINAGE



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 36

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.0	CODES AND STANDARDS	4
3.00.0	EXECUTION	7
4.00.00	TESTING AND ACCEPTANCE CRITERIA	36
5.00.00	MEASUREMENT	36



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 36

**Standard Technical Specification
For Road and Drainage**

1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

1.01.00 Works to Be Provided by The Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

- a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc. all required for the completion of the work.
- b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc.) to the engineer for approval.
- c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

1.02.00 Work to Be Provided by Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

1.03.00 Conformity with Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 4 OF 36
1.04.00	Materials to Be Used All materials required for the work shall be the best commercial variety and as approved by the engineer. 2.00.00	Codes and Standards All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise. a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC b) IRC: 19 - Standard specification and code of practice for Water bound Macadam c) IRC: SP 11 - Hand Book of Quality Control for Construction of Roads and Runways d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete. e) IS:2212 - Code of Practice for Brick work f) IS: 783 - Code of Practice for Laying of Concrete Pipes g) IS: 1201 - Methods of testing tar and bituminous materials to 1220 h) IS: 73 - Specification for paving bitumen i) IS: 215 - Specification for Road tar j) IS: 216 - Coal tar pitch k) IS: 217 - Specification for cut-back bitumen l) IS: 454 - Specification for cut-back bitumen from waxy crude m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non-extruding and resilient type Part I Bitumen impregnated fibre



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 36

Part II CNSL Aldehyde resin and coconut pith

- o) IS: 334 - Glossary of terms relating to bitumen and tar
- p) IS: 1077 - Common burnt clay building bricks
- q) IS: 3117 - Specification for bitumen emulsion roads (anionic type)
- r) IS: 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements
- s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

2.01.00

Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of $\pm 25\text{mm}$ therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be $\pm 40\text{mm}$.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade	$\pm 25 \text{ mm}$
Sub-base	$\pm 20 \text{ mm}$
Base course	$\pm 15 \text{ mm}$
Wearing course	$\pm 10 \text{ mm}$



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 36

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

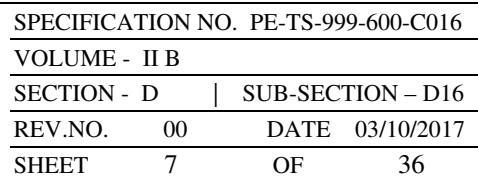
c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the center of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE -I

**PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT
COURSES**

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge					Cross Profile
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8



Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 36

3.02.00 Clearing and Grubbing

Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc. shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

3.03.00 Filling in Embankment

3.03.01 General

The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However, the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 36

Table - II

Density Requirements of Embankment Materials

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part - VII)
1.	Embankment upto 3m height	Not less than 1.44 gm/cc
2.	Embankment exceeding 3m height and embankment of any height subject to long period of inundation	Not less than 1.52 gm/cc
3.	Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified)	Not less than 1.65 gm/cc

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

3.03.02

Setting Out

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc. required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skew/corner points. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 36

3.03.03 Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

3.03.04 Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tons' roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of atleast 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

3.03.05 Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source of supply and if found less than that specified for compaction, the same shall

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 36

be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

3.03.06**Compaction**

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials. Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 36

Table - III

Compaction Requirements for Embankment

Sl. No.	Type of work/material	Field dry density as a percentage of maximum laboratory dry density as per IS: 2720, Part-VII
1.	Top 0.5m portion of embankment below sub-base and shoulders	Not less than 100
2.	Other portions of embankment	Not less than 95

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing with Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 36

free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03**Placing The Sods**

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc. and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04**Staking the Sods**

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 14 OF 36
	3.04.05 Top Dressing After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water. 3.04.06 Watering and Maintenance The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance. 3.05.00 Shoulder Construction 3.05.01 Description This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer. 3.05.02 Materials Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards. 3.05.03 Construction Operations Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer. In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted. Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the	

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 15 OF 36
	pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required cross fall shall be maintained to drain off surface water. 3.06.00 Kerb 3.06.01 Material Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level. 3.06.02 Laying The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm. The gap shall be filled with cement mortar as specified. The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer. 3.07.00 Sub-base (Granular Sub-base) 3.07.01 Description This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer. 3.07.02 Materials The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 16 OF 36

**Table - IV
Grading for Granular Sub-Base Material**

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3
80 mm	100	100	100
63 mm	90 - 100	90 - 100	90 - 100
4.75 mm	35 - 70	40 - 90	50 - 100
75 micron	0 - 20	0 - 25	0 - 30
Minimum CBR value for the fraction of material passing 20 mm sieve.	30 %	25%	20%

Note: The materials passing 425micron sieve for all the three gradings when tested according to IS: 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS: 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS: 2720, Part VII and soaking the same in water for 4 days.

3.07.04 Spreading and Compacting

Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetation's and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 17 OF 36

Moisture content of the loose material shall be checked in accordance with IS: 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS: 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompact.

3.08.00 Water Bound Macadam Sub-base/Base Course**3.08.01 Description**

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in conformity with the lines, grades and cross-sections shown on the approved drawings.

3.08.02 Materials**a) Coarse Aggregates - General Requirements**

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 18 OF 36

Table – V

Physical Requirements of Coarse Aggregates for Water Bound Macadam

S.No.	Type of Construction	Test	Test method	Requirements
1.	Sub-base	Los Angeles Abrasion Value * or Aggregate Impact Value	IS: 2386 (Part IV) IS: 2386 (Part IV) or IS: 5640**	50 percent maximum 40 percent maximum
2.	Base	a) Loss Angeles Abrasion value* or Aggregate Impact Value b) Flakiness Index ***	IS: 2386 (Part IV) IS: 2386 (Part IV) or IS: 5640 ** IS: 2386 (Part I)	50 percent maximum 40 percent maximum 15 percent maximum

* Aggregates shall satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water shall be tested for impact value under conditions in accordance with IS: 5640.

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

b) Crushed or Broken Stone

Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

c) Grading Requirements of Coarse Aggregates

The coarse aggregates shall conform to one of the gradings given in Table – VI. However, the use of Grading-1 shall be restricted to sub-base courses only.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 19 OF 36

**Table - VI
Grading Requirements of Coarse Aggregates**

Grading	Size range	Sieve designation	Percent by weight passing the sieve
1.	90mm to 40 mm	100 mm 80 mm 63 mm 40 mm 20 mm	100 65 - 85 25 - 60 0 - 15 0 - 5
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 90 - 100 35 - 70 0 - 15 0 - 5
3.	50 mm to 20 mm	63 mm 50 mm 40 mm 20 mm 10 mm	100 95 - 100 35 - 70 0 - 10 0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75-micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 20 OF 36

**Table - VII
Grading for Screenings**

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm	100
		10.0 mm	90 - 100
		4.75 mm	10 - 30
		150 micron	0 - 8
B	10 mm	10 mm	100
		4.75 mm	85 - 100
		150 micron	10 - 30

e) Binding Material

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS: 2720, Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03

Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the center line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 21 OF 36

done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 22 OF 36

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 23 OF 36
	3.09.00 Tack Coat 3.09.01 Description The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction. 3.09.02 Materials The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback. 3.09.03 Construction Operations a) Preparation of Base The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder. b) Application of Binder Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction. 3.10.00 Bituminous Macadam Binder Course 3.10.01 Description This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 24 OF 36

3.10.02

Materials

a) Binder

The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with IS: 73.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII

Physical Requirements of Aggregates for Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	IS: 2386 (Part IV)	35 percent maximum
2.	Aggregate Impact Value *	IS: 2386 (Part IV)	30 percent maximum
3.	Flakiness Index	IS: 2386 (Part I)	35 percent maximum
4.	Stripping Value	IS: 6241 (Part IV)	25 percent maximum
5.	Water Absorption	IS: 2386 (Part III)	2 percent maximum

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 25 OF 36

Table-IX

Aggregates Grading for 75mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X

Aggregates Grading for 50mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 - 100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 26 OF 36

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportion of materials and producing a uniform mix. A variation in binder content upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03

Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However, in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 27 OF 36

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tons' power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the center longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 28 OF 36
	surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it. The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it. 3.11.00 Open Graded Premix Carpet 3.11.01 Description This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification. 3.11.02 Materials a) Binder The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable. b) Aggregates The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30. c) Proportioning of Materials The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 29 OF 36

Table - XI

Quantity of Materials Required for 10 Sq. M of Road Surface for 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet

i)	Stone Chippings - 12mm size; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
ii)	Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
Total		0.27 Cu.m

Binder for premixing (quantities in terms of straight run bitumen)

i)	For 0.18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m	9.5 Kg
ii)	For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m	5.1 Kg
Total		14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 30 OF 36

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However, application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material is laid, rolling shall be commenced with 6 to 8 tons' power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the center longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the center line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 31 OF 36
	with a thin surface coat of approved binder before the new mix is placed against it. f) Seal Coat A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed. 3.12.00 Seal Coat 3.12.01 Description This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber. Type-A: Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings. Type-B: Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder. 3.12.02 Materials a) Binder The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS: 73, 217 or 454 as applicable or any other approved cutback. The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively. b) Stone Chippings for Type a Seal Coat The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m. per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 32 OF 36

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180-micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03

Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present a uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 33 OF 36

binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However, in case of Type- A seal coat, the traffic shall not be permitted until the following day.

3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc. or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

3.14.00 Road Side Drains

3.14.01 Drains

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown

	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 03/10/2017 SHEET 34 OF 36
	on approved drawing, drains shall be of R.C.C. construction with necessary slopes. 3.15.00 Culverts Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the “Specification for Earthwork in Excavation and Backfilling”, backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable. 3.16.00 Pipe Culverts and Drainage Pipes 3.16.01 Materials The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS: 458 and shall be procured from approved manufacturers with collars as per manufacturer’s specification. The tenderer shall specifically mention the particular manufacturer’s product he proposes to use. Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383. 3.16.02 Laying of Pipes Laying of concrete pipes shall correspond to IS:783 and as per the specification given below. a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc. as required shall be done by the Contractor. Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per “Specification for Earthwork in Excavation and Backfilling” to the	

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 03/10/2017

SHEET 35 OF 36

satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS: 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc. as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 03/10/2017

SHEET 36 OF 36

f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS: 783.

3.16.03 Relation with Water Supply Pipeline

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

3.17.00 Manholes and Inspection Chambers

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

4.00.00 Testing and Acceptance Criteria

All testing as mentioned in the specification and as mentioned in Clause No. 900 of the “Specification for Roads and Bridge Works, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer.

5.00.00 MEASUREMENT

Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION FOR
FABRICATION OF STRUCTURAL
STEEL WORK**

SPECIFICATION NO. PE-TS-999-600-C017

VOLUME - II B

SECTION - D SUBSECTION -D17

REV.NO. 0 DATE 03/10/2017

SHEET 1 OF 41

VOLUME: II B

**SECTION - D
(PART I)**

SUB-SECTION – D 17

FABRICATION OF STRUCTURAL STEEL WORK



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
FABRICATION OF STRUCTURAL
STEEL WORK**

SPECIFICATION NO. PE-TS-999-600-C017

VOLUME - II B

SECTION - D SUBSECTION -D17

REV.NO. 0 DATE 03/10/2017

SHEET 2 OF 41

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	WORKMANSHIP	19
4.00.00	INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY	29
5.00.00	INFORMATION TO BE SUBMITTED	33
6.00.00	RATES AND MEASUREMENTS	34

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 3 OF 41
SUB-SECTION – D XVII FABRICATION OF STRUCTURAL STEEL WORK 1.00.00 SCOPE This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract. 2.00.00 GENERAL 2.01.00 Work to be provided for by the Contractor The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval. b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made. c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings. d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections, e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification. f) Suitably mark, bundle, and pack for transport all fabricated materials. g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork. h) Insure, load and transport all fabricated steelwork field connection materials to site.		

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017
		VOLUME - II B
		SECTION - D SUBSECTION -D17
		REV.NO. 0 DATE 03/10/2017
		SHEET 4 OF 41
	i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract. 2.02.00 Work by others No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract. 2.03.00 Codes and standards All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed: IS: 226 - Structural steel (Standard Quality) IS: 800 - Code of Practice for general construction in steel. IS: 806 - Code of practice for use of steel tubes in general building construction. IS: 808 - Rolled steel beams, channels, and angle sections IS: 813 - Scheme of symbols for welding IS: 814 - Covered electrodes for metal arc welding of structural steel IS: 815 - Classification and coding of covered electrodes for metal arc welding of structural steels. IS: 816 - Code of practice for use of metal arc welding for general construction in mild steel IS: 817 - Code of practice for training and testing metal arc welders IS: 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations IS: 822 - Code of practice for inspection of welds IS: 919 - Recommendations for limits and fits for Engineering	

 Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017			
		VOLUME - II B			
		SECTION - D		SUBSECTION -D17	
		REV.NO.	0	DATE	03/10/2017
		SHEET	5	OF	41
IS: 961 - Structural Steel (High Tensile) IS: 1148 - Rivet bars for structural purposes IS: 1149 - High tensile rivet bars for structural purposes IS: 1161 - Steel Tubes for structural purposes IS: 1200 - Method of measurement of steelwork and ironwork (Part 8) IS: 1239 - Mild Steel Tubes IS: 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (Dia 6 to 24 mm) IS: 1364 - Precision and semi-precision hexagon bolts, screws, nuts and 1 locknuts (Dia, range 6 to 39 mm) IS: 1367 - Technical supply conditions for threaded fasteners IS: 1442 - Covered electrodes for the metal are welding of high tensile structural steel IS: 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube IS: 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes. IS: 1731 - Dimensions for steel flats for structural and general engineering purposes IS: 1852 - Rolling and cutting tolerances for hot-rolled steel products IS: 1977 - Structural steel (ordinary quality) St-42-0 IS: 2062 - Steel for General Structural Purposes IS: 2074 - Ready mixed paint, red oxide Zinc chromate priming IS: 2595 - Code of Practice for Radiographic Testing IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles					

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017			
		VOLUME - II B			
		SECTION - D		SUBSECTION -D17	
		REV.NO.	0	DATE	03/10/2017
		SHEET	6	OF	41
IS: 3757 - High strength structural bolts IS: 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products IS: 7205 - Safety Code for Erection of Structural Steelwork IS: 7215 - Tolerances for fabrication of steel structures IS: 7280 - Bare wire electrodes for submerged arc welding of structural steels. IS: 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.					
2.04.00		Conformity with Designs			
The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.					
2.05.00		Materials to be used			
2.05.01		General			
All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section.					
The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and					

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 7 OF 41
	amperage (Polarity in case of D.C. supply) for which the electrodes are suitable. 2.05.02 Steel All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable: a) IS: 2062 - Steel for general structural purposes b) IS: 961 - Structural steel High Tensile c) IS: 1977 - Structural steel (Ordinary quality) St-42-0 In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable. 2.05.03 Rivet Steel All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable: a) IS: 1148 - Rivet Bars for structural purpose b) IS: 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired. 2.05.04 Electrodes All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable a) IS: 814 - Covered electrodes for metal arc welding of structural steel b) IS: 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel c) IS: 1442 - Covered electrodes for the metal arc welding of high tensile structural steel	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 8 OF 41
	d) IS: 7280 - Bare wire electrodes for submerged arc welding of structural steels 2.05.05 Bolts and Nuts All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners. Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable. a) Mild Steel All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 $\sqrt{A}$, where "A" is the cross sectional area of the test specimen i) IS: 1367: Technical supply conditions for threaded fasteners ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube b) High Tensile Steel The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer. 2.05.06 Washers Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract: a) IS: 2062 - Steel for general structural purposes b) IS: 961 - Structural Steel (High Tensile Quality) c) IS: 1977 - Structural steel (Ordinary Quality) St-42-0 d) IS: 6649 - Hardened washers	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 9 OF 41
2.05.07	Paints Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready Mixed Paint, Red oxide Zinc Chromate Priming.	
2.06.00	Coal Bin	
2.06.01	Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have been conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.	
2.06.02	For general requirements, fabrication and construction details IS: 9178 (Pt. I & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.	
2.06.03	The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.	
2.06.04	Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.	
2.06.05	Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.	
2.07.00	New Erection Marks	
2.07.01	Additional structures involving new erection marks may be required to be added at any stage of work.	
2.07.02	All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.	
2.07.03	All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 10 OF 41
	2.08.00 ELECTRO FORGED STEEL GRATINGS 2.08.01 Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc. 2.08.02 All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise. 2.08.03 The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed. 2.08.04 The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance. 2.08.05 Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses. 2.08.06 The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained. 2.08.07 Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars. 2.08.08 Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel. 2.08.09 Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 12 OF 41																					
	the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection. 2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633. 2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose. 2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection. 2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains. 2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost to the Owner. 2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item) 2.10.01 Material In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed. Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used. <table> <tr> <th>Material</th><th>%</th><th>Remarks</th></tr> <tr> <td>Carbon</td><td>10.03%</td><td>Max.</td></tr> <tr> <td>Silicon</td><td>1.60%</td><td>Max.</td></tr> <tr> <td>Manganese</td><td>0.80% to 1.50%</td><td></td></tr> <tr> <td>Phosphorous</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Sulphur</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Chromium</td><td>10.80% to 12.50%</td><td></td></tr> </table>	Material	%	Remarks	Carbon	10.03%	Max.	Silicon	1.60%	Max.	Manganese	0.80% to 1.50%		Phosphorous	0.03%	Max.	Sulphur	0.03%	Max.	Chromium	10.80% to 12.50%		
Material	%	Remarks																					
Carbon	10.03%	Max.																					
Silicon	1.60%	Max.																					
Manganese	0.80% to 1.50%																						
Phosphorous	0.03%	Max.																					
Sulphur	0.03%	Max.																					
Chromium	10.80% to 12.50%																						

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 14 OF 41
	will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store. c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above. 2.10.04 Cuffing Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded. 2.10.05 Jointing Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test. 2.10.06 Bending The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile. 2.10.07 Welding sequence The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer. 2.10.08 Acceptance Criteria of Fabricated Structures The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 15 OF 41
	results from the inspection and testing of the welded structure joints and the test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215. 2.11.00 BEARINGS 2.11.01 PTFE (Poly tetra fluorethylene) slide bearing a) General The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm. b) Material PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm. The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm². c) Installation The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 16 OF 41
	beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed. 2.12.00 Storage of material 2.12.01 General All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks. 2.12.02 Steel The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather. 2.12.03 Electrodes The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating. 2.12.04 Bolts, Nuts and Washers Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality. 2.12.05 Paints Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 17 OF 41
2.13.00	Quality Control The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor. Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work. The quality control procedure shall cover but not be limited to the following items of work a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. b) Rivets, Bolts, : Manufacturer's certificate, dimension checks, Nuts & Washers material testing. c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating. d) Welders : Qualifying Tests e) Welding sets : Performance Tests f) Welds : Inspection, X-ray, Ultrasonic tests g) Paints : Manufacturer's certificate, physical inspection reports h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 18 OF 41
2.14.00	Standard dimensions, forms and weights The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.	
2.15.00	Fabrication Drawings The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval. The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents. The fabrication drawings shall include but not limited to the following: - Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections. - Dimensional drawings of base plates, foundation bolts location etc. - Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings. - Complete Bill of Materials and detailed drawings of all sections as also their billing weights. - Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof. These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 19 OF 41
	necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length. The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract. 3.00.00 WORKMANSHIP 3.01.00 Fabrication 3.01.01 General All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent. 3.01.02 Straightening Material Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C. 3.01.03 Cutting Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 20 OF 41
	expert hand, subject to the approval of the Engineer. To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion. 3.01.04 Planning of edges Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer. 3.01.05 Clearances The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided. 3.02.00 Riveted and bolted construction 3.02.01 Holes Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them. Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 21 OF 41
3.02.02	specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly. Holes for rivets or bolts shall not be formed by gas cutting process. Assembly All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained. Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C. Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required. Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole. All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 22 OF 41
	section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary. Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer. Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings. 3.03.00 Welded Construction 3.03.01 General Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817. 3.03.02 Preparation of material Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch. 3.03.03 Assembling Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°). The work shall be positioned for flat welding whenever practicable.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 23 OF 41
3.03.04	Welding Sequence In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements. In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer. 3.03.05 Welding technique All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness. Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract. To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards. 3.03.12 Temperature No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 24 OF 41
	precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard. 3.03. 13 Peening Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening. 3.03. 14 Equipment These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer. 3.04.00 Finish Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butt over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm. 3.05.00 Slab bases and caps Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017			
		VOLUME - II B			
		SECTION - D		SUBSECTION -D17	
		REV.NO.	0	DATE	03/10/2017
		SHEET	25	OF	41

3. 12.00

Lacing bars

The ends of lacing bars shall be neat and free from burns.

3. 13.00

Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.14.00

Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.15.00

Floor Grating

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively, diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

3.10.00

Chequered Plates

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 26 OF 41
3.11.00	Architectural Clearances Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances. 3.11.00 Shop connections a) All shop connections shall be otherwise riveted or welded as specified on the Drawings. b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection. c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer. 3.13.00 Castings Steel castings shall be annealed. 3.14.00 Shop erection The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 27 OF 41
3.15.00	Shop painting	
3.15.01	General	
	Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.	
	After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.	
3.15.02	Inaccessible parts	
	Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.	
3.15.03	Contact surfaces	
	Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.	
3.15.04	Finished surfaces	
	Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.	
3.15.05	Surfaces adjacent to field welds	
	Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 29 OF 41
	not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer. 4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY 4.01.00 Inspection Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification. The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification. 4.02.00 Testing and Acceptance Criteria 4.02.01 General The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test. 4.02.02 Steel All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor. All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 30 OF 41
4.02.02	Welding a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc. b) Non-destructive examination shall be carried out to determine soundness of weldments as follows: i) 10% at random on fillet-joints. ii) 100% on all butt-joints. c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs. d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.	
4.02.04	Rivets, bolts, nuts and washers All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.	
4.02.05	Shop painting All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 31 OF 41
	4.02.12 Galvanizing All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products. 4.03.00 Tolerance The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures. 4.04.00 Acceptance Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost. When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract. 4.05.00 Delivery of materials 4.05.01 General The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 32 OF 41
	4.05.02 Marking Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection. 4.05.03 Shipping Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit. Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following: a) Name and address of the consignee b) Name and address of the consignor c) Gross weight of the package in tonnes and its dimensions d) Identification marks and/or number of the package e) Custom registration number, if required All markings shall be carried out with such materials as would ensure quick drying and indelibility. Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers. Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially - a) Name of the Contractor b) Number and date of the Contract c) Name of the office placing the contract d) Nomenclature of stores	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 33 OF 41
	e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each. The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads. After delivery of the materials at site, all packing materials shall automatically become the property of the Owner. Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor. The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges. If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor. Necessary advice regarding the shipment with relevant details shall reach the Engineer at least a week in advance. 5.00.00 INFORMATION TO BE SUBMITTED 5.01.00 With Tender The following information is required to be submitted with the Tender: a) Progress Schedule The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work. i) Preparation and approval of fabrication drawing ii) Procurement of Materials iii) Fabrication and shipping of all anchor bolts iv) Fabrication and shipping of main steelwork.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 34 OF 41
	v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable. vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork. vii) Final date of completion of all shipments. b) Shop Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted. 5.02.00 After Award After award of the Contract the successful Tenderer is to submit the following: a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule. b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information. c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials. d) Results of any test as and when conducted and as require by the engineer. e) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 35 OF 41
6.00.00	RATES AND MEASUREMENT	
6.01.00	Rates	
6.01.01	The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications.	
6.01.02	The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures.	
6.01.03	The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work.	
6.01.04	No claims shall be entertained, if the details shown on the 'Released for Construction' drawings differ from those shown on the bid/tender drawings.	
6.01.05	Rates shall be inclusive of all leads and lifts/elevation.	
6.01.06	The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces'/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 36 OF 41
	The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site. Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ. 6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC. 6.01.08 The bidder's rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the primer specified. 6.01.09 The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint. 6.01.10 The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint. 6.01.11 The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration. 6.01.12 The bidder's rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification. 6.01.13 The bidder's rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 37 OF 41
6.01.14	The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unutilized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member. The bidder should prepare an optimised cutting plan as per fabrication drawing to utilise the steel material upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/contract specifications.	
6.01.15	The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.	
6.01.16	The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.	
6.01.17	The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces'/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 39 OF 41
	from assumed minimum circumscribing rectangular area for the purpose of payment. 6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m. 6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment. 6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment. 6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for welding/bolting. 6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds. 6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units. 6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 03/10/2017 SHEET 41 OF 41
6.02.26	The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION – D18

REV.NO. 0 DATE 03/10/2017

SHEET 1 OF 17

VOLUME: II B

**SECTION - D
(PART I)**

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 2 OF 17

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	WORKMANSHIP	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	12
5.00.00	INFORMATION TO BE SUBMITTED	16

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 3 OF 17
SUB-SECTION – D 18 ERECTION OF STRUCTURAL STEELWORK 1.00.00 SCOPE This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract. 2.00.00 GENERAL 2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following: a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork. b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part. c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures. d) Checking centre lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks. e) Aligning, plumbing, levelling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer. f) Painting of the erected steel structures.		



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 4 OF 17

- g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:
- i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
 - ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.
 - iii) Reaming of holes for use of higher size rivet or bolt if required.
 - iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.
 - v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.
 - vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
 - vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:

IS: 800 - Code of practice for general construction in steel.

IS: 456 - Code of practice for main or reinforced concrete.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions of the Engineer.

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 5 OF 17
	2.05.00 Material 2.05.01 General All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore. 2.05.02 Materials to conform to Indian standards All materials required to be supplied by the Contractor under this contract shall conform to the relevant Indian Standard specifications. 2.06.00 Storage of Materials 2.06.01 General All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues. 2.06.02 Yard The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work. The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.	

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C018	
	TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	VOLUME - II B	
		SECTION - D	SUBSECTION - D18
		REV.NO. 0	DATE 03/10/2017
		SHEET 6	OF 17

2.06.03

Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00

Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work:

- i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.
- iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00

Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00

WORKMANSHIP

3.01.00

Erection

3.01.01

Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 7 OF 17

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

**TITLE:****TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 8 OF 17

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.

No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. "Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 9 OF 17

there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times Dia or 200 mm	Bolt length exceeding 8 times Dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) (Kg.M) of IS:1367	Torque to be applied for bolt class 8.8
20	59.94
22	81.63
24	103.73

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 10 OF 17
	Note: The above torque values are approximate for providing tensions of 14.7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench. In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating. Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause. 3.01.08 Field Welding All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. 3.01.09 Holes, Cutting and Fitting No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer. The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work. 3.02.00 Drifting Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge	

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 11 OF 17
3.03.00	holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed. Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited. Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced) Grouting shall be carried out with Ordinary Cement grout as described below: The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings. No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position. Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned. If required by the Engineer, certain admixtures like aluminium powder, “ironite” or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval. 3.04.00 Painting after Erection Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance	

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 12 OF 17
	with the requirements of the specification for fabrication of structural steelwork applicable for the project. Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust. All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet. Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted. The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved “Schedule of Painting”. The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932. 3.05.00 Final cleaning up Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work. 4.00.00 TESTING AND ACCEPTANCE CRITERIA 4.01.00 General Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable	

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 13 OF 17
	and appropriate time extensions will be allowed. The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer. 4.01.01 Stiffness Test In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test. 4.01.02 Strength Test The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours. In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load. 4.01.03 Structure of same design Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 03/10/2017

SHEET 14 OF 17

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with respect to building line	
	i) In longitudinal direction	i) ± 3.0 mm
	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018
		VOLUME - II B
		SECTION - D SUBSECTION – D18
		REV.NO. 0 DATE 03/10/2017
		SHEET 15 OF 17
	other member connection levels: i) For a column upto and including 10M height ii) For a column greater than 10M but less than 40M height c) For adjacent pairs of columns across the width of the building prior to placing of truss d) For any individual column deviation of any bearing or resting level from levels shown on drawings. e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating Trusses least. Trusses Crane Cirders	i) ± 3.5 mm from true vertical ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ± 7 mm per 30m length. ± 9.0 mm on true span. ± 3.0 mm 3.0 mm 1/1500 of the span or greater than 10mm whichever is the centre of bottom chord. 1/250 of depth of truss or 20 mm which ever is the - least. 2.0 mm. ± 3.0 mm

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 03/10/2017 SHEET 16 OF 17
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding. 1.0 mm. d) Deviation of crane rail axis from centre line of web. ± 3.5 mm Setting of Expansion gaps At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length. iv) For Building without Cranes The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise. 4.03.00 Acceptance Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract. 5.00.00 INFORMATION TO BE SUBMITTED 5.01.00 Before Tender 5.01.01 Tentative Programme The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.	



TITLE:

TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION – D18

REV.NO. 0 DATE 03/10/2017

SHEET
17
OF
17

5.01.02

Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03

Erection Yard

A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.02.00

After award of the Contract

After award of the contract, the Contractor shall submit the following:

5.02.01

Detailed Programme

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.02.02

Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-999-600-C019

VOLUME - II B

SECTION - D | SUB-SECTION – D19

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 7

VOLUME: II B

SECTION - D

SUB-SECTION – D19

ROOF DECKING

SPECIFICATION NO. PE-TS-999-600-C019



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-999-600-C019

VOLUME - II B

SECTION - D | SUB-SECTION – D19

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 7

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	3
4.00.00	ACCEPTANCE CRITERIA	6
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	7

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 03/10/2017 SHEET 3 OF 7
<u>ROOF DECKING</u> 1.00.00 Scope This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings. 2.00.00 Material 2.01.01 Roof of main plant TG and Deaerator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and center to center of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins. 3.00.00 INSTALLATION The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein. The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work. 3.01.00 Detailed Design of Roof Decking The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets, fixtures, flashings and trims. After approval he shall supply further eight copies.		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 03/10/2017 SHEET 4 OF 7
	The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained. 3.02.00 Erection & Fixing 3.02.01 Sequence of Manufacture/Erection Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps. 3.02.02 Position and Location of Laps Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind. The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof. 3.02.03 Alignment of Sheets and Fixings All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds. 3.02.04 Site Cutting Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps. 3.02.05 Damaged Sheets Distorted, blemished or water stained sheets and any other fittings shall not be used.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 03/10/2017 SHEET 5 OF 7
	3.02.06 Laps End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm. 3.02.07 End Lap Fixings End lap fixings shall be located at least 25 mm from the end of each sheet. 3.02.08 Side Lap Fixings The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation. 3.02.09 Holes Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc. 3.02.10 Location and Spacing of Fixings Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins. 3.02.11 Fixings The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self-drilling / self-tapping screws of minimum thread diameter of 5.6mm. These self-drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer's	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 03/10/2017 SHEET 6 OF 7
	recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets. 3.03.00 Protection during Construction Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times. 3.04.00 Damage Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 Acceptance Criteria The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked: a) Side and end laps b) Absence of damage in the sheeting. c) Conformity of fixings with the approved design. 5.00.00 IS Codes All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 513- Specification for cold rolled carbon steel sheets. IS: 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion. IS: 4431 - Specification for carbon & carbon manganese free cutting steel. IS: 1573 - Electroplated Coatings of zinc on iron and steel.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 03/10/2017 SHEET 7 OF 7
6.00.0 6.01.00 6.02.00	RATES AND MEASUREMENTS Rates Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage. Method of Measurement Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size. No payments shall be made for laps.	



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D20

FALSE FLOORING

SPECIFICATION NO. PE-TS-999-600-C020



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	4
4.00.00	ACCEPTANCE CRITERIA	5
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION - D20

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 6

FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supplies of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of + 0.2mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of ± 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 6

2.02.01 Strength

Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

2.02.02 Surface finish

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

2.02.03 Damaged Floor Panels

Distorted, blemished or stained floor panels shall not be used.

2.03.00 Skirting

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

3.00.00 INSTALLATION

3.01.00 Base

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimize dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

Any damage to the sub floor during installation of the false flooring system

	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-999-600-C020 VOLUME - II B SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 03/10/2017 SHEET 5 OF 6
	shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment. All installation work of the false flooring system shall be supervised by the manufacturer's authorized representative. 3.03.00 Painting After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint. 3.04.00 Protection during Construction All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner. 3.05.00 Damage Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 ACCEPTANCE CRITERIA The false flooring system shall only be accepted after completion of following checks: - Level - Alignment of joints - Thickness of joints - Surface finish - Colour and texture - Details of edges, junctions etc. - Performance - Criteria specified for strength.	



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 6

5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS:5318 Laying of flexible sheet and flooring.

IS:3462 Flexible PVC flooring

IS:3087 Wood particle boards (medium density) for general purposes.

6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.

6.02.00 Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 26

VOLUME: II B

SECTION - D

SUB-SECTION – D21

BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-999-600-C021



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 26

CONTENTS

CLAUSE NO.	DESCRIPTION	
1.00.00	SCOPE	3
2.00.00	GENERAL REQUIREMENTS	3
3.00.00	MATERIALS	5
4.00.00	PILE INSTALLATION	6
5.00.0	SAMPLING, TESTING, AND QUALITY ASSURANCE	12
6.00.00	PILE TESTING	15
7.00.00	CODES AND STANDARDS	16
8.00.00	RATES AND MEASUREMENT	17
	ANNEXURE-A	
	ANNEXURE-B	
	ANNEXURE-C	
	ANNEXURE-D	
	TABLE - 1	



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 03/10/2017

SHEET 3 OF 26

**TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED
CAST-IN-SITU PILES**

1.00.00 SCOPE

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

2.00.00 GENERAL REQUIREMENTS

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carry out the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pull-out loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C021
	TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	VOLUME - II B
		SECTION - D SUB-SECTION - D21
		REV.NO. 00 DATE 03/10/2017
		SHEET 4 OF 26
2.09.00	The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.	
2.10.00	In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However, no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.	
2.11.00	In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.	
2.12.00	It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.	
2.13.00	The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.	
2.14.00	The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.	
2.15.00	AVAILABLE SUB-SOIL DATA An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 5 OF 26
	3.00.00 MATERIALS 3.01.00 General All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used. 3.02.00 CONCRETE Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456. 3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5. 3.02.02 Grade and minimum cement content Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M³ of concrete shall be used for M-20 grade concrete. 3.02.03 Slump of concrete The slump of concrete shall vary between 150 to 180 mm. 3.03.00 REINFORCEMENT 3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786. 3.03.02 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile. 3.03.03 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.	

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C021
	TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	VOLUME - II B
		SECTION - D SUB-SECTION - D21
		REV.NO. 00 DATE 03/10/2017
		SHEET 6 OF 26

3.03.04	The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.
3.03.05	Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pilebore by providing necessary laps as per IS: 456.
3.03.06	The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.
3.03.07	The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction.
3.03.08	Laps shall be staggered as far as practicable and not more than 50% bars shall be lapped at a particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).
3.03.09	Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.
3.03.10	Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.
3.03.11	Bundling of bars is not permitted.
4.00.00	PILE INSTALLATION
	Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.
4.01.00	Equipment and Accessories
4.01.01	The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.
4.01.02	List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C021
	TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 03/10/2017
		SHEET 7 OF 26

4.01.03	The capacity of the rig shall be adequate so as to reach the specified founding level.
4.01.04	Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.
4.02.00	Installation Criteria
4.02.01	For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892.
4.02.02	For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926.
4.02.03	In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.
4.02.04	Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.
4.02.05	A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.
4.02.06	The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied.
4.02.07	Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021
		VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 03/10/2017
		SHEET 8 OF 26
4.03.00	Control of position and alignment	
4.03.01	Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911 Part I/Sec. 2, which is reproduced below for ready reference. a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment. b) Piles shall not deviate more than 75 mm or D/4 whichever is less (75mm or D/10 whichever is more in case of piles having diameter more then 750mm) from their designed position at the working level.	
4.04.00	Boring	
4.04.01	Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.	
4.04.02	The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.	
4.04.03	Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.	
4.04.04	Use of drilling mud (bentonite slurry) for stabilizing the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.	
4.04.05	The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.	
4.04.06	The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021
		VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 03/10/2017
		SHEET 9 OF 26
	method is used the bentonite slurry shall be under constant circulation till start of concreting.	
4.04.07	The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.	
4.05.00	Chiselling	
4.05.01	Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.	
4.06.00	Cleaning of Pile bore	
4.06.01	On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.	
4.06.02	Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.	
4.06.03	Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.	
4.06.04	Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.	
4.07.00	Adjacent Structures	
4.07.01	When working near existing structures care shall be taken to avoid any damage to such structures.	
4.08.00	Concreting	
4.08.01	The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the minimum specified strength in accordance with IS: 456 at requisite workability (slump).	
4.08.02	Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 10 OF 26
	4.08.03 The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor. 4.08.04 Proper placement of the reinforcement cage to its full length shall be ensured before concreting. 4.08.05 Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level. 4.08.06 The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5. 4.08.07 Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud. 4.08.08 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast. 4.08.09 The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed. 4.09.00 Cut off level (COL) 4.09.01 Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer. 4.09.02 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap. 4.09.03 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of one metre above COL.	

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 11 OF 26
	4.10.00 Sequence of Piling 4.10.01 Each pile shall be identified with a reference number. 4.10.02 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles. 4.11.00 Building up of Piles 4.11.01 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built-up by using atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile. 4.12.00 Breaking off of Piles 4.12.01 If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer. 4.13.00 Preparation of Pile head 4.13.01 The soil surrounding the piles shall be excavated upto the bottom of the lean concrete below the pile cap, with provision for working space, sufficient enough to place shuttering, reinforcement, concreting and any other related operations. 4.13.02 The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile. 4.13.03 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap. 4.13.04 The pile top shall be embedded into the pile cap by 50mm or clear cover to reinforcement, whichever is higher. 4.13.05 All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.	

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 12 OF 26
	4.14.00 Rejection and Replacement of Defective Piles 4.14.01 The Engineer reserves the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner. 4.15.00 Recording of Piling Data 4.15.01 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Engineer within two days of completion of concreting of the pile. 5.00.00 SAMPLING, TESTING AND QUALITY ASSURANCE 5.01.00 Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test. 5.02.00 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works. 5.03.00 Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shall be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner. 5.04.00 Quality Assurance Programme a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting	

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 13 OF 26
	up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results. b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications. 5.05.00 Testing of Concrete 5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced). 5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days. 5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength. 5.05.04 In preparation of test cubes or specimen's vibrators shall not be used. 5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles. 5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced). 5.05.07 The acceptance criteria shall be as mentioned in Table-1. 5.06.00 Testing for position and alignment 5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 14 OF 26
5.06.02	Permissible limits for deviation shall be as specified under clause no. 4.03.	
5.07.00	Properties of Drilling mud	
5.07.01	Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified elsewhere with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.	
5.07.02	Density of the drilling mud shall be checked in each pile before concreting.	
5.08.00	Check for Pile bore	
5.08.01	On completion of boring and cleaning the bottom of each pilebore shall be checked from the sample collected from near the bottom of pile bore or by any other methods as approved by the Engineer, to ensure that it is free from pilebore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Engineer.	
5.08.02	For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted. - A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content. - Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.	
5.09.00	Pile Integrity test	
5.09.01	Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test. Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting.	
5.09.02	The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to	



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 03/10/2017

SHEET 15 OF 26

testing the integrity of the shaft and is not intended to replace the use of static load testing.

5.09.03

Low Strain Integrity Test Methodology:

- a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test.
- b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis.
- c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within its length these will set up secondary reflections, which will be added to the return signal.
- d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles.
- e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete.
- f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile.
- g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile.

6.00.00

PILE TESTING

Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.

6.01.00

INITIAL LOAD TEST

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 16 OF 26
	mentioned in bill of quantities. 6.02.00 ROUTINE LOAD TEST Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be borne by the contractor. 7.00.00 CODES AND STANDARDS All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 432 - Specification for mild steel and medium tensile steel bars (Part 1 & 11) and hard drawn steel wire for concrete reinforcement. IS: 456 - Code of practice for plain and reinforced concrete. IS: 1200 - Measurement of Building and Civil Engineering works (Part 23) Piling. IS: 1786 - Code of practice for twisted steel high strength deformed bars for concrete reinforcement. IS: 1892 - Code of practice for Subsurface Investigation for foundation. IS: 2131 - Method of Standard Penetration Test for Soils IS: 2911 - Code of practice for design and construction of pile foundations - Bored cast-in-situ concrete piles. IS: 2911 - Code of practice for design and construction of pile foundation - Load test on piles. IS: 6926 - Code of practice for Diamond Core Drilling for Site Investigation for River Valley Projects. IS: 10262 - Recommended guidelines for concrete mix design.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 17 OF 26
8.00.00	RATES AND MEASUREMENTS The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts. 8.01.00 Rates 8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements. 8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer. 8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work. 8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification. 8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner. 8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results. 8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile location, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials,	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 18 OF 26
	equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc. 8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock. 8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer. 8.01.10 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tack welding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc. 8.02.11 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates. 8.01.12 The quoted rate for piling shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc. 8.01.13 The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results. 8.01.14 Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not have been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc. 8.02.00 Measurement 8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be	

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 03/10/2017 SHEET 19 OF 26
	considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level. 8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner: i) The weight shall be arrived at by multiplying the actual length measured along with standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement. ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones. iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured. 8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL. 8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock. 8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.	



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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 20 OF 26

ANNEXURE-A

Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pull out/Tension (MT)
*	*	*	*
*	*	*	*

A2. Installation criteria

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

A2.1 In Soil/weathered Rock

- Minimum length of the pile shall be _____* m below COL.
- The pile shall be terminated after penetrating through the strata having SPT penetration less than ____* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

- Piles shall be installed and socketed into the rocks for a length (socketing length) equal to _____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.
- Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 21 OF 26

Installation criteria

Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 22 OF 26

ANNEXURE-B

List of Equipments

S. No	Description	Capacity No.
1.	Piling Rigs	
2.	Chisel	3 T min 6 T max
3.	High pressure Mud Pumps	10 HP min 25 HP max
4.	Bentonite mixing plants	
5.	Concrete batching plant	
6.	Soil testing equipments	

Note:

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 23 OF 26

ANNEXURE-C

Bentonite suspension used for piling work shall satisfy the following requirements

- a) Liquid limit of bentonite when tested in accordance with IS: 2720(Part V) shall be more than 300 percent and less than 450 percent.
- b) Sand content of the bentonite powder shall not be greater than 7 percent.
- c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 1.25 gm/ml.
- d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.
- e) The differential free swell shall be more than 540 percent.
- f) The pH value of the bentonite suspension shall be between 9 and 11.5.



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 03/10/2017

SHEET 24 OF 26

ANNEXURE-D

PILE DATA

1. Reference No. Location (Co-ordinates) _____ area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring.
10. Depth of Ground water table in the vicinity.
11. Type of soil at pile tip
12. Method of boring operation
13. Details of drilling mud as used:
 - i) Freshly supplied mud
 - Liquid limit -
 - Sand content -
 - Density -
 - Marsh viscosity -
 - Swelling index -
 - pH value -
 - ii) Contaminated mud
 - Density -
 - Sand content -

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 03/10/2017

SHEET 25 OF 26

14. SPT* N values in soil (from the nearest bore hole).
+UCS** value in rock (from the nearest bore hole).

* Standard penetration Test
** Unconfined compression strength
15. Chiselling if any, from..... m to m
16. Date and time of start and completion of concreting.
17. Method of placing concrete
18. Concrete quantity
Actual

Theoretical
19. Ref. Number of test cubes
20. Grade and slump of concrete
21. Results of test cubes
22. Reinforcement details:
Main Reinforcement
No. _____
Dia. _____
Depth _____

Stirrups: Type
No. _____
Dia. _____
Spacing _____
23. Any other information regarding obstructions, delay and other interruption to the sequence of work.



TITLE:

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

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 03/10/2017

SHEET 26 OF 26

TABLE -1

FREQUENCY OF SAMPLING AND TESTING

Sl. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Pilebore size a) diameter b) length		Physical measurement	each pile	as per specification
2.	Founding level	to establish socketing horizon/ and or founding level & upto depth 5m below founding level.	in separate borehole meant for the purpose a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic properties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C As per annexure C
4.	Position and Alignment	-	Physical or any Approved method	Each Pile	As per Cl. 4.3
5.	Cleaning of pilebore	-	As per Cl. 5.8	Each Pile	Pilebore be free from bored material debris/sludge
6.	Reinforcement (R/F) Spacing of longitudinal R/F cover laps binding of laterals		Physical inspection and measurement	each cage	As per approved design
7.	Concrete a) Workability b) Cubes	Slump cone test Compressive Strength test	Each pile As per spec.	As per Cl. 5.5 As per Cl. 5.5	As per specification. As per IS: 456
8.	Materials like aggregate, sand etc.	As per technical specification for concrete and relevant IS codes			
9.	Pile head		Physical	each pile	



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 16

VOLUME: II B

SECTION - D

SUB-SECTION – D22

SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 16

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	SCOPE	3
3.00.00	MATERIALS	4
4.00.00	QUALITY CONTROL	6
5.00.00	EXECUTION	6
6.00.00	RATES AND MEASUREMENTS	15

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 4 OF 16

2.04 Work to be provided by others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.05 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise.

IS: 1200 Methods of measurement of building and civil engineering works,
Part-1: Earthwork

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earthwork on canals

IS: 6922 Criteria for safety and design of structures subject to underground
Blasts

In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.

2.06 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

3.00 MATERIALS

All materials required for the work shall be of best variety and approved by the engineer.

3.01 Materials for Excavation

For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 16

a) Soil

It includes all type of soil including laterite, moorum etc. with/without any percentage of kankar which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc. and those which do not fall under **clause 3.01 (b) and (c)** etc.

b) Soft Rock

It includes the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc. and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiseling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02**Materials for Filling**

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

- a) Materials from swamps, marshes and bogs
- b) Expansive clays
- c) Peat, logs, sod and perishable materials
- d) Materials susceptible to combustion
- e) Any material or industrial and domestic produce which will adversely affect other materials of work
- f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 6 OF 16

approved earth to fill the voids as far as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc. shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00**QUALITY CONTROL**

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00**EXECUTION**

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc. within 15 days of award of the contract to the engineer for approval.

5.01**Site Clearance**

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc. with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 7 OF 16

woods etc. shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02**Setting Out**

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03**Excavation**

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 8 OF 16

filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

5.03.01 Excavation in Hard Rock

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

5.03.02 Blasting**a) General**

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to

transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

b) Materials

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 9 OF 16

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 10 OF 16

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 11 OF 16

holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc. and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc. shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc. shall be taken during blasting operations.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 12 OF 16

5.03.04 Restrictions on Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one meter and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiseling or any other suitable method as approved by the engineer.

5.04 Sorting of Excavated Materials

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as far as possible for ease of measurement. The materials heaped shall be utilized as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

5.05 Disposal of Surplus/ Waste Materials

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.

5.06 Earth Work in Filling

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tons' roller. The approved earth/fill material shall then be spread in horizontal layers' not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 03/10/2017

SHEET 13 OF 16

determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc. making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720, part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 03/10/2017 SHEET 14 OF 16
	layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers. 5.07 Dewatering and Drainage It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas. 5.08 Finishing Operations Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, cross-sections and dimensions as shown on the approved drawings or as directed by the engineer. 5.09 Turfing Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage. The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be roughened and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.	

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 03/10/2017

SHEET 16 OF 16

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in

stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-999-600-C023

VOLUME - II B

SECTION - D | SUB-SECTION – D23

REV.NO. 00 DATE 03/10/2017

SHEET 1 OF 5

VOLUME – II B

SECTION – D

SUB SECTION – D23

ANTI-TERMITE TREATMENT

SPECIFICATION NO. PE-TS-999-600-C023



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-999-600-C023

VOLUME - II B

SECTION - D | SUB-SECTION – D23

REV.NO. 00 DATE 03/10/2017

SHEET 2 OF 5

TABLE OF CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	EXECUTION	3
3.00.00	ACCEPTANCE CRITERIA	4
4.00.00	RATES	4
5.00.00	METHOD OF MEASUREMENT	4
6.00.00	I.S. CODES	5

	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-999-600-C023	
		VOLUME - II B	
		SECTION - D	SUB-SECTION – D23
		REV.NO. 00	DATE 03/10/2017
		SHEET 3	OF 5

**TECHNICAL SPECIFICATION FOR
ANTI-TERMITE TREATMENT**

1.00.00

SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.00.00

EXECUTION

2.01.00

General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00

Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals	Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable (IS 8944 - 1978)	: 1.0
Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)	: 0.5
Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	: 1.0

2.02.01

Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column

	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-999-600-C023 VOLUME - II B SECTION - D SUB-SECTION – D23 REV.NO. 00 DATE 03/10/2017 SHEET 4 OF 5
	pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose. 2.02.02 Treatment of Top Surface of Plinth Filling Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces. 2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building. 2.02.04 Treatment of Expansion Joints These shall receive special attention and shall be treated in a manner approved by the Engineer. 2.02.05 Treatment at Junction of the Wall and the Floor Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface. A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. 3.00.00 ACCEPTANCE CRITERIA The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.	



TITLE:

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

SPECIFICATION NO. PE-TS-999-600-C023

VOLUME - II B

SECTION - D | SUB-SECTION – D23

REV.NO. 00 DATE 03/10/2017

SHEET 5 OF 5

4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

5.00.00 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This includes treatment, to foundations, walls, trenches, basements, plinth, buried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

6.00.00 I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings
Pre-constructional chemical treatment measures.



TITLE:

QUALITY ASSURANCE TESTS AND
INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

REV. 0

DATE 03/10/2017

SHEET 1 of 6

VOLUME: II B

SECTION – D

SUB SECTION – D24

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

REV. 0

DATE 03/10/2017

SHEET 2 of 6

QUALITY ASSURANCE TESTS AND INSPECTION

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test		* For Test at S.No. 1, 2, 6 & 7 frequency of test shall be one in every 2000 M³ for each type & source of fill material. # Frequency of test for Sr. No. 3, 4 & 5 shall be one in every 5000 M³ for each type & source of fill material. @ For foundation filling, one for every 10 foundations for each compacted layer. However for heavily loaded foundations, each layer shall be tested. For area filling, one for every 1000 M² area for each compacted Layer. Note: The contractor shall include provision for setting up testing laboratory with all apparatus and equipments necessary for carrying out field tests.
All tests as per Indian/International STDS	11	Y Y
Dry Density by Proctor Needle Penetration @	10	- Y
Relative Density Index @	9	- Y
Dry Density by core cutter/sand display cut @	8	- Y
Moisture Content *	7	Y -
STD Proctor Test *	6	Y -
Chemical Analysis #	5	Y -
Free Swell Index #	4	Y -
Shrinkage Limit #	3	Y -
Liquid Limit & Plastic Limit *	2	Y -
Grain Size Analysis *	1	Y -
Test Requirements		
Item/Components		
1. EARTH WORK		
a) Earth Fill Material (Before Compaction)		
b) Earth Fill Material (After Compaction)		



TITLE:

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

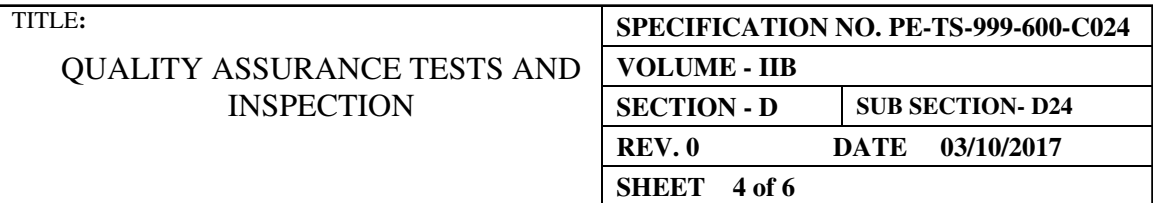
REV. 0

DATE 03/10/2017

SHEET 3 of 6

CIVIL & STRUCTURAL WORKS

CIVIL & STRUCTURAL WORKS						
Remarks/Frequency of Test		* Quantum of check for test at Sr. No 1 & 2 shall be one per 100 m ³ or part thereof or change of source whichever is earlier.	# To be done every day before start of work.	Note: For test at Sr. No. 3, 4, 5, 6, 7, 8, 9, 11& 12 once per source. For remaining as per IS Code.		
All tests as per IS-Codes	21	Y	Y	Y		
Rebound Hammer Test	20	-	-	Y		
Cement Content	19	-	-	Y		
W.C. Ratio	18	-	-	Y		
Slump and Compaction Factor	17	-	-	Y		
Harmful substance	16	-	-	Y		
pH Value	15	-	-	Y		
Crushing Strength	14	-	-	Y		
Setting Time	13	-	-	-		
Petrographic Exam.	12	Y	Y	-		
Silt, Clay and organic impurities	11	-	Y	-		
Bulkage	10	-	Y #	-		
Mortar Making Properties	9	-	Y	-		
Deleterious Matl. And MICA content	8	Y	Y	-		
Flakiness Index	7	Y	-	-		
Reaction with Alkali	6	Y	Y	-		
Soundness	5	Y	Y	-		
Mech. Properties	4	Y	-	-		
Specific Gravity, Density, Void, Absorption	3	Y	Y	-		
Moisture Content	2	Y *	Y #	-		
Particle Size and Shape Sieve analysis	1	Y *	Y *	-		
Test Requirement Checks	Item/Components	2. CONCRETING				
		a) Coarse Aggregate	b) Fine Aggregate/Sand	c) Cement	d) Water	e) Concrete





TITLE:

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

REV. 0

DATE 03/10/2017

SHEET 5 of 6

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test

1. Quantum of check for R. T. on butt welds under tension zone shall be 100% and for remaining butt welds unless specified shall be 10%. Acceptances norms for NDTs shall be as per AWS D1.1
2. RT on all butt welds for bunker supporting girders (Longitudinal/Transverse) shall be 100 %.
3. RT on all butt welds for deaerator supporting girders shall be 100 %.
4. All site fillet welds of bunker supporting structure shall be 100 % NDT.
5. All above quality control and super vision shall be carried out by an independent inspection body.
- * 100% on 'T' joints and 10% on longitudinal and circumferential butt welds.

Hydraulic test

Y

All tests as per Indian/International Codes/Standards

Y

Y

Dimensional

Y

Y

Mechanical Test of Butt Weld Coupons

Y

-

Macrotech Exam. of Fillet Welds Coupons

Y

-

Fit up/Assy

Y

Y

Visual Exam.

Y

Y

Radiographic Test (RT) on Welds

Y

Y*

Liquid Penetration Test (LPT) on Welds

Y

Y

WPS/PQR/WQR

Y

Y

Ultrasonic Test (UT) on Material Above 40 mm Thickness

Y

-

Material T.Cs

Y

Y

Test Requirements

Item/Components

15. Structural Steel Like Columns, Girders, Beams & Truss Etc.

16. C.W. Pipes/Ducts

TITLE:

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C024

VOLUME - IIB

SECTION - D

SUB SECTION- D24

REV. 0

DATE 03/10/2017

SHEET 6 of 6

CIVIL & STRUCTURAL WORKS

[illegible]



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 1 of 41

VOLUME: II B

SECTION – D

SUB SECTION – D25

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 2 of 41

TABLE OF CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.0.0	SCOPE	3
2.0.0	GENERAL	3
3.0.0	EXECUTION	14
4.0.0	TESTING AND ACCEPTANCE CRITERIA	37
5.0.0	INFORMATION TO BE SUBMITTED	38

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 3 of 41	

TECHNICAL SPECIFICATION FOR REINFORCED CONCRETE CHIMNEY

1.0.0 SCOPE

This specification covers reinforced cement concrete works, including brick flue and insulation work, painting and protective treatment work, and other works associated with construction of RCC single flue chimney.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

Work to be provided by the Contractor, unless specified otherwise, shall include but shall not be limited to the following:

- a) Furnish all labour, supervision, services, insurance, material, power, fuel forms, templates, supports, scaffolding, tools, plants, construction equipment, approaches, transportation etc. required for the entire work.
- b) Design and prepare working drawings for formworks, scaffoldings, supports, staging hoisting arrangement for men and material etc. and submit them for approval.
- c) Prepare and submit for approval, as per approved schedule, detailed drawings for RCC work in shell, platforms at various levels, roof and ground floor and bending schedules for reinforcement bars, showing the positions and details of spacers, chairs, supports, hangers, openings etc.
- d) If in scope, prepare detailed fabrication and erection marking drawings for steel flues including flue expansion compensators, steel flue supports and restraint arrangements along with fittings and accessories and submit them for approval.
 - e) Prepare and submit for approval detailed shop drawings, with list of materials and material specifications for Load Bearing Insulation Blocks and Lateral Restraint Insulation Blocks.

	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 4 of 41	

- f) Prepare and submit for approval detailed schemes for operations like material handling, placement of concrete erection of steel flues, fixing of insulations, installation, dismantling and maintenance of flue expansion compensator etc. and for items like approaches, services etc.
- g) Design and submit for approval mix proportions for concrete to be adopted on job.
- h) Furnish samples and submit for approval the results of tests for various properties of the following materials:
 - i) Ingredients of concrete, (ii) Concrete,
 - iii) Acid/Chemical Resistant Tiles, (iv) Castable refractories, (v) Insulation materials, (vi) Paints. (vii) S/S liner.
- i) Provide all incidental items not specified or shown on drawings in particulars but reasonably implied or necessary for successful completion of the work in accordance with drawings and specifications.
- j) Produce, if directed by the Engineer, a guarantee, in approved proforma, for satisfactory performance, for a specified period, of material manufactured by specialist firms.

2.2.0 **Work by Others**

No work under this specification will be provided for by agency other than the Contractor for this Contract unless specifically mentioned otherwise in the Contract.

2.3.0 **Codes and Standards**

All works under this Specification, unless specified otherwise, shall conform to the latest revisions/replacements of the following Indian Standard Codes, Criteria, Specifications, along with those mentioned therein. In case any particular aspect of work is not covered by Indian Standards, other standard specification, as may be specified by the Engineer, shall be followed. "IS Specification" shall mean Codes, Criteria etc. of ISI.

- IS:6 Moderate heat duty fireclay refractories, Group-A.
- IS:104 Ready mixed paint, brushing, zinc chrome, priming.
- IS:158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 5 of 41	
IS:195 Specification for fire clay mortar for laying fireclay refractory bricks. IS:269 Ordinary, and low heat Portland cement. IS:383 Coarse and fine aggregates from natural sources for concrete. IS:432 Mild steel and medium tensile steel bars. IS:456 Code of practice for plain and reinforced concrete. IS:516 Methods of test for strength of concrete. IS:732 Code of practice for electrical wiring installations (System Voltage not exceeding 650 Volts). IS:800 Code of practice for general construction in steel. IS:813 Scheme of symbols for welding. IS:814 Covered electrodes for metal arc welding of structural steel. IS:816 Code of practice for use of metal arc welding for general construction in mild steel. IS:817 Code of practice for training and testing of metal arc welders. IS:818 Code of practice for safety and health requirements in electric and gas welding and cutting operations. IS:822 Code of procedure for inspection of welds. IS:875 Draft Standard for Code of practice for structural safety of buildings loading standards. IS:1080 Code of practice for design and construction of simple spread foundations. IS:1139 Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcements. IS:1161 Steel tubes for structural purposes. IS:1199 Methods of sampling and analysis of concrete. IS:1200 Methods of measurement of building works.			

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-620-C002	
	RCC STACK	VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 6 of 41	
IS:1230	Cast Iron Rainwater pipes and fittings.		
IS:1239 (Part-I)	Mild steel tubes.		
IS:1367	Technical supply conditions for threaded fasteners.		
IS:1526	Sizes and shapes for firebricks (230 mm. series).		
IS:1554	Cables.		
IS:1566	Hard-drawn steel wire fabric for concrete reinforcement.		
IS:1608	Methods for tensile testing of steel products.		
IS:1730	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.		
IS:1731	Dimensions for steel flats for structural and general engineering purposes.		
IS:1786	Cold-twisted steel bars for concrete reinforcement.		
IS:1791	Batch type concrete mixers.		
IS:1893	Criteria for Earthquake Resistant Design of Structures.		
IS:1947	Flood light.		
IS:1977	Structural steel (ordinary quality).		
IS:2062	Weldable structural steel.		
IS:2074	Ready mixed paint, red oxide - zinc chrome priming.		
IS:2309	Code of practice for the protection of buildings and allied structures against lightning.		
IS:2386 (Part-I)	Methods of test for aggregates for concrete. Particle size and shape.		
IS:2386 (Part-II)	Estimation of deleterious materials and organic impurities.		
IS:2386 (Part-III)	Specific gravity, density, voids, absorption and bulking.		
IS:2386 (Part-IV)	Mechanical properties.		
IS:2386	Soundness.		

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-620-C002	
	RCC STACK	VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 7 of 41	
(Part-V) IS:2386 (Part-VI) Measuring mortar making properties of fine aggregate. IS:2386 (Part-VII) Alkali aggregate reactivity. IS:2386 (Part-VIII) Petrographic examination. IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement. IS:2505 Concrete vibrators, immersion type. IS:2506 Screed board concrete vibrators. IS:2633 Methods of testing uniformity of coating on zinc coated articles. IS:2722 Portable swing weighbatchers for concrete (single and double bucket type). IS:2750 Steel scaffoldings. IS:2751 Code of practice for welding of mild steel bars used for reinforced concrete construction. IS:2950 Code of practice for design and construction of raft foundations. IS:3025 Methods of sampling and test (Physical and Chemical) for water used in industry. IS:3043 Code of Earthing. IS:3144 Methods of Test for Mineral Wool Thermal Insulation Material. IS:3346 Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot- plate method). IS:3495 (Part-I to IV) Method of test for clay building bricks. IS:3550 Methods of test for routine control for water used in industry. IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.			

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-620-C002	
	RCC STACK	VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 8 of 41	
IS:3677 Unbonded rock and slag wool for thermal insulation. IS:4014 Code of practice for steel tubular scaffolding. (Part-I&II) IS:4031 Method of physical tests for hydraulic cement. IS:4457 Ceramic Unglazed Vitreous acidresistant tiles. IS:4634 Method for testing performance of batch-type concrete mixers. IS:4687 Gland packing asbestos. IS:4832 Chemical Resistant mortars. IS:4860 Acid-resistant bricks. IS:4990 Plywood for concrete shuttering work. IS:4998 Criteria for design of reinforced concrete chimneys. (Part-I) IS:5410 Cement paint, colour as required. IS:5445 Long fluted machine reamers with Morse taper shanks. IS:5495 Sizes and shapes for firebrick (300 mm. and higher series). IS:6911 Stainless Steel plate, sheet and strip. IS:8112 High strength ordinary portland cement. IS:8183 Bonded Mineral Wool. IS:9595 Recommendation for Metal Arc Welding of Carbon and Carbon Manganese steels. CP326 - British Standard - Protection of structures against lightning. NEPA NO. 78 Code of protection against lightning. The Indian Electricity Rules. The requirements of Department of Civil Aviation, Govt. of India.			
2.4.0	Conformity with Drawings and Specifications		

	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 9 of 41	

The Contractor shall carry out all the work in strict accordance with the drawings stamped "Released for Construction" and specification issued to him and as per Contractor's detailed drawings approved by the Consulting Engineer. Prior to concreting, the Contractor shall prepare a check list on a set format of all items of work involved, and inform the Engineer well in advance so that the Engineer shall have the opportunity of satisfying himself if the works mentioned in the format are done according to drawings and specification, and he can allow the Contractor in writing to start pouring of concrete. The entire operation of concreting shall be carried on as per specification, to the complete satisfaction of the Engineer. No deviation from the drawings will be allowed unless otherwise directed by the Engineer in writing.

For Load Bearing Thermal Insulation block assembly and lateral restraint insulation block assembly, Contractor shall design sizes of all components of the blocks and details of their connections, supply and fabricate the same in accordance with the approved shop drawings prepared by him.

For steelwork and metal work, the Contractor shall design all connections, inserts for scaffolding, supply and fabricate all steelwork and metal work and furnish all connection materials in accordance with approved shop drawings prepared by him and/or as instructed by the Engineer, keeping in view the maximum utilization of the available sizes and shapes for metal components.

2.5.0 **Materials to be used**

2.5.1 **General Requirement**

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.

2.5.2 **Cement**

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 10 of 41	

Ordinary Portland cement of grade 43, as per the requirements laid down in IS:8112, shall be used, until otherwise stated elsewhere in the specification.

2.5.3 Coarse Aggregate

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The maximum size of coarse aggregate for stack superstructure shall be 25 mm down graded, unless otherwise stated (vide serial 5(b) of clause 3.03.06). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

2.5.4 Fine Aggregate

Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned in the relevant IS Specifications.

2.5.5 Water

The water for both mixing and curing of concrete shall be clean, free from oil, acid, alkali, organic or other deleterious substances. Contractor shall test the water as and when required by the Engineer.

2.5.6 Reinforcement

Mild steel or Medium or High Tensile steel deformed bars specified for reinforcement shall conform to the latest relevant IS Specifications and shall be of tested quality under ISI

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 11 of 41	

Certification Scheme. The reinforcement shall be free from any oil, foreign material or mill or rust scales.

2.5.7 Steel Flue

- a) All mild steel material to be used in construction of steel flue shall comply with IS:2062, IS:1239, IS:1367, IS:1608, IS:800 and with other relevant IS Specifications. The ultimate tensile strength of this steel shall not be less than 410 N/Sq.mm.
- b) Stainless steel liners shall be fabricated using materials conforming to the requirements of relevant IS Specifications and/or AISI 316L or BS:1449 Part-2. Grade of Stainless steel shall be equivalent to BS:1449 (Part-2) 316 S.12.
- c) Materials to be used for fabrication of Flue expansion compensator shall be suitable for the flue gas temperature and shall be acid resisting.

The Expansion compensator shall comprise several layers of materials given below in order from the gas side.

- i) Two layer of insulation, each consisting of heavy weight texturized glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 Kg/Sq.m
- ii) A continuous filament glass cloth coated both sides with a fluoro-elastomer having an approximate weight of 1.5 Kg/Sq.m.
- iii) Two layers of PTFE (Poly Tetra Fluoro-Ethylene) film of minimum thickness 0.15 mm each.
- iv) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 Kg/Sq.M.

2.5.8 Paints

Paints to be used for shop coat of fabricated steel shall conform to the IS:2074. Paint for treatment of outside face of Chimney with Cement water proof paint shall conform to IS:5410.

2.5.9 Acid Resistant Tiles and Castable Refractories



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 12 of 41

Acid resistant tiles to be provided over roof of stack should conform to IS:4457. Matching mortars to be used for tiles. Castable refractories shall be of hydraulic setting, rapid hardening type. It shall have refractory properties similar to Fire bricks conforming to IS:6, Group-A and working temperature shall be upto 1350 Deg.C.

2.5.10 Insulations

a) On Exterior Surface of Flues

The normal flue gas temperature inside the flue shall be 145 Deg.C with momentary rise upto 400 Deg.C (Maximum) occasionally. The insulation material shall be able to withstand this temperature without any deterioration in thermal properties or breakdown. The thermal conductivity of the insulating material shall not exceed 0.06 W/M Deg.C at a mean temperature of 150 Deg.C. The insulation shall also not be affected by any acid condensation from flue gas and shall be free from any impurities which may cause corrosion to the flue material.

For steel flues 65 mm thick semi rigid resin bonded fibrous mineral wool of density not less than 96 Kg/Cu.m as per IS:8183 or resin bonded fibrous crown glass wool (high temperature) of same thickness and density not less than 36 Kg/Cu.m capable of sustaining temperature to the tune of 540 Deg.C without any loss of material thermal property, may be used. The mineral wool for exposed top portion of flue shall be semi-rigid with minimum density of 200 Kg/Cu.M or the glass wool for exposed top portion of flue shall have minimum density of 75 Kg/Cu.M.

Slag wool insulation shall not be accepted.

The insulation free from shots should be supplied in the form of mat to be fixed with staggered joints on outer surface of the flue with suitably spaced stud by galvanised wire mesh. Insulation on the top portion of flue shall be covered by stainless steel cladding.

b) At Load Bearing and Side Restraints of Flues

Load bearing insulation assembly to have (i) a properly mechined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead/elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 and stainless

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 13 of 41	

steel plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and Mild steel to IS-2062. SINDANYO BLOCKS shall be suitable for operation at 320 Deg.C and shall primarily satisfy the following physical properties :

- i) Minimum compressive stress prior to onset of compression yield of not less than 12 N/Sq.mm.
- ii) Minimum shear strength of 30 N/Sq.mm when tested in accordance with BS:3497-1979.
- iii) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200 Deg.C and its coeff. of linear expansion not to exceed 1.2×10^{-5} per Deg.C.
- iv) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved by the Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration and intrusion of foreign matter and to ensure the preservation of their quality and characteristics for the work. Any material, which is deteriorated or is damaged or is otherwise considered defective by the Engineer, shall not be used for construction and shall be removed from site immediately, failing which the Engineer shall be at liberty to get the materials removed. The Contractor shall maintain an upto date accounts of receipt, issue and balance of all materials issued by the Owner.

2.6.2 Cement

Contractor shall store cement in water-tight and properly designed stores so that the Cement can be kept dry and the stock can be handled in rotation. The doors of stores shall

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 14 of 41	

be at least 30 cm. above G.L. Deteriorated cement shall be removed immediately from the site. Not more than ten bags of cement shall be stacked one above the other.

2.6.3 Aggregate

Different materials shall be transported, handled and stored separately in such a manner as to prevent damage, deterioration or contamination. Stock piles of fine and coarse aggregates shall be allowed to drain, so that aggregates do not contain too much water.

2.6.4 Reinforcement

Reinforcement shall be stored preferably under cover and stacked off ground in size and grade-wise separate stacks for easy identification.

2.6.5 Steel, Metal and Fittings

All steel, metal and fittings to be used for fabrication and erection shall be stored sectionwise and lengthwise in separate stacks, off ground, so that they can be handled, inspected, measured and accounted for easily at any time. If required by the Engineer, the materials may have to be stored in a covered shed.

2.6.6 Paints

Paints shall be stored under cover, in air-tight containers. Paints supplied in sealed containers shall be used as soon as possible once the container is opened. Left over paints shall be kept in air-tight containers.

2.6.7 Steel Flue

Fabricated pieces of steel (flue) liner shall be stored systematically for ease of handling.

2.6.8 Insulation Material

All insulation materials like bearing insulation blocks, restraint insulation blocks, glass or mineral wool, asbestos ropes etc. shall be stored in packing boxes, under covered shed, avoiding their coming in contact with objectionable matter.

2.7.0 Quality Control

Contractor shall establish and maintain quality control for different items or work and materials as may be directed by the Engineer to assure compliance with contract requirement and submit to the Engineer records of the same.

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 15 of 41	

The Contractor shall submit all records and test results in original to the Engineer for his approval, if so desired by him.

The quality control operation shall include but shall not be limited to the following items of work :

- a) Cement : Test to satisfy relevant IS Specifications if supplied by the Contractor.
- b) Aggregate : Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.
- c) Water : Impurities Test.
- d) Reinforcement: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.
- e) Structural : Material tests or certificate to satisfy Steelrelevant IS Specification if supplied by the Contractor.
- f) Steel flue : Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.
- g) Stainless : Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.
- h) Acid Resistant : Compressive and tensile strength, acid tiles& mortar resistance and water absorption test.
- i) Mortar : Compressive and tensile strength, adhesion and acid resistance test.
- j) Insulation : Thermal conductivity, density, heat and acid resistance tests. Bearing capacity will be tested for bearing/restraint insulation blocks.

3.0.0 EXECUTION

3.1.0 Concrete

3.1.1 Trial Mix, Grades of Concrete

 BHEL Bharat Heavy Electricals Limited	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 16 of 41	

At least three weeks before commencing any concreting in the work the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded.

For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Contractor. The Contractor's design mix shall fall within limits of the following tables :

- i) Strength requirements of concrete : Table-2 of IS:456-2000.
- ii) Concrete Mix Proportion : Table-3 of IS:456-2000.
- iii) Minimum cement content/Cu.m. of finished concrete shall be as per Table 5 of IS 456-2000.
However, it should be noted that minimum cement content for concrete of chimney shell of grade M30,M35,M40 shall be 400kg, 430 kg and 450 kg respectively.
- iv) Limit of consistency : Refer Table in Item 3.1.4 of this specification.
- v) Cement/Total Aggregate Ratio : As per the following table.



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 17 of 41

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE)

3.1 CEMENT/TOTAL AGGREGATES RATIOS

Workability	Water/ Cement Ratio	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement to Crushed Stone Aggregate	
		20 mm. Size	38 mm. size	20 mm. size	38 mm. size
Very Low slump 0-25 mm.	0.4	01:04.8	01:05.3	01:04.5	1:05
	0.5	01:07.2	01:07.7	01:06.5	01:07.4
	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low slump 25-50 mm	0.4	01:03.9	01:04.5	01:03.5	1:04
	0.5	01:05.5	01:06.7	1:05	01:05.5
	0.6	01:06.8	01:07.4	01:06.3	1:07
	0.7	1:08	01:08.5	01:07.4	1:08
Medium slump 50-100mm.	0.4	01:03.5	01:03.8	01:03.1	01:03.6
	0.5	01:04.8	01:05.7	01:04.2	1:05
	0.6	1:06	01:07.3	01:05.2	01:06.2
High slump 100 - 175 mm.	0.4	01:03.2	01:03.5	01:02.9	01:03.3
	0.5	01:04.4	01:05.2	01:03.9	01:04.6
	0.6	01:05.4	01:06.7	01:04.7	01:05.7
	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE-1 : Notwithstanding anything mentioned above, the cement / Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer.

It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water-cement ratios which may be required to be used in mass concrete work only.

	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 18 of 41	

NOTE-2 : The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes. For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Engineer. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a significant change in the quality of any of the ingredients for concrete, at the discretion of the Engineer.

3.1.2 Batching of Concrete

For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer.

3.1.3 Mixing of Concrete

Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the manner specified. The mixer shall then rotate for at

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 19 of 41	

least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer, before a different quality of concrete is put through the mixer and also at the end of day's work.

3.1.4 Workability of Concrete

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. 120 mm to 150 mm, where concrete is pumped, otherwise, 100mm-120mm slump in chimney shell works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 3.3.6). The usual limits of consistency for various types of structure are given below:



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 20 of 41

LIMITS OF CONSISTENCY

Degree of Workability	Slump in mm. with Standard Concrete		Use for which Concrete is suitable
	Min.	Max.	
Very Low	0	15	Large mass concrete work with heavy compaction equipment.
Medium	35	65	Deep and wide RCC structures with congestion of reinforcement and inserts.
1.1.1 High RCC structures		65	100 Very narrow and deep
1.1.2			with congestion due to reinforcement
1.1.3			and inserts.

NOTE: The above table is for guidance only. Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer, the compacting factor test, in accordance with IS:1199, shall be carried out.

3.1.5 Placing and Compaction of Concrete

Concreting shall proceed in a manner directed by the Engineer, concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.

The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow

	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 21 of 41	

each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set.

The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed.

Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated.

To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork.

A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use.

3.1.6 Curing of Concrete

Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Contractor shall plan and employ proper equipment and sufficient labour considered adequate by the Engineer under able supervisor for curing.

	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 22 of 41	

3.1.7 Construction Joints

In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.

3.1.8 Ordinary Concrete

Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS:456.

3.2.0 Reinforcement

3.2.1 Bending of Reinforcement

All bars shall be carefully and accurately bent by the Contractor in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS:2502.

3.2.2 Placing

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 23 of 41	

All reinforcement shall be placed and maintained in the position shown in the drawings.

Contractor shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Contractor shall provide adequate number of separators, with the approval of the Engineer. Any additional support to the reinforcing cage, if required at the time of concreting, shall also be provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer.

3.2.3 Fixing of Reinforcement

18 SWG annealed steel wire shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.

 BHEL Bharat Heavy Electricals Limited	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 24 of 41	

3.10 Forms

Construction by Slip-form Method

Slip-form construction shall be for construction of the wind shield. Type of Slip-form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view.

The Tenderer should furnish a brief but comprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Owner at the time of submitting Tender. This statement shall include the following items:

- i) Type and description of Slip-form equipment and its accessories.
- ii) Design of scaffolding and staging.
- iii) Description of materials including admixtures to be used for construction.
- iv) Manpower planning, construction spaces required, standby arrangement.
- vi) Rate of Slip-forming.
- vii) Proposed workability requirement of concrete and type of cement & admixture to be used.
- viii) Quality assurance programme.
- ix) Method of Transportation of material
- x) Method of curing and rectification of defects.

 BHEL Bharat Heavy Electricals Limited	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 25 of 41	

- xi) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.
- xii) Contingency solution for unplanned interruptions.
- xiii) Time of completion.

While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Tenderer.

Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Tenderers, while quoting for Slip-form method of construction:

1. Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps are advisable:
 - a) Shutter plates have to be smooth and should be thoroughly clean. Before fixing them in position all the surfaces which will be coming in contact with concrete to have a coat of epoxy paint.
 - b) In areas where concrete thickness is 750 mm or more, rate of pouring should be such that minimum slipping of shuttering is maintained to avoid initial set of concrete before slip form movement.
 - c) Mix design should be so done that it will be self- lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates.
 - d) Mix design also should be so done that it has a slump of around 100mm-120mm, at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose.

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 26 of 41	
These admixtures to be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used. Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40 Deg.C. 2. Care must be taken to prevent twist, which predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned this work together with rectifying any defect. 3. Every endeavour has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken: a) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite jacks at any instant of time should not exceed 5 mm. b) Loading on Slip-form truss/yokes has to be fairly equal. c) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeve should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm around. 4. For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry. 5. In designing the mix following aspects should be borne in mind: a) Cement used should have an initial setting time of not less than 50 minutes and preferably should have a specific surface around 3600 Sq.Cm.per gram. b) Coarse and fine aggregates should be well graded and rounded aggregates offer better performance in Slip-form technique. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates.			

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 27 of 41	
c) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 450 Kg. per Cu.M of concrete. d) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slipform proceeds should be between 0.1 to 0.2 Newton/ Sq.mm. e) It is advisable to use cement from a single source during the entire operation of slipform technique since once the system starts, there might not be any time left for conducting trial mixes if the source of procurement of cement changes. 6. Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slipform operation. 7. It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at great heights. In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a stand-by pump for effective utilisation of the system. 8. Rate of slipping should be around 100 mm – 150mm per hour, subjected to a maximum limit of 3.0 m per 24hrs. 9. Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc. It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 Tonne/ 6 Tonne capacity and a hydraulic pump with necessary pipe connections. Spacing of yoke legs should preferably be kept within 2 metres to prevent overloading on jacks and consequent failure resulting in twist of the formwork.			

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 28 of 41	
Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks. 10. At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck. 11. In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke. 12. For effective utility of this technique following areas need careful attentions at the very conceptual stage: a) Detailed quality assurance programme. b) Advance Planning and preparations. c) Arrangement for on site supervision and adequate access facilities. 13. Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slipform technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be approved by Engineer before starting the actual work. 14. Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement. Vertical reinforcements should be kept vertical by providing suitable holders within the slipform system. 15. It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilised for various maintenance activities, removal of jack rods etc. 16. Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and			

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 29 of 41	
reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete. For movement of personnel supervising the work a seperate hoist must be arranged for. 17. The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system alongwith slipform. 18. Winches for lifting men and material and mixers, if located within unnsafe area around chimney, should be protected by adequate shelter from possible damage. 19. Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below. 20. A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results. Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers. 21. In case of interruption in the course of slipping of formwork following measures should be taken: a) Provision of a key and additional reinforcement at the junction of new and old concrete. b) Slip form system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete. c) Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout. d) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer. e) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel. 22. It is preferable to suspend the construction work under high wind condition. 23. It is of utmost importance that for effective implementation of this system an Engineer fully conversant with Slip form technique with			

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 30 of 41	
enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators, having experience of similar construction in past. It is to be noted that enough manpower (as agreed by owners engineer at site) of above mentioned quality, is always ensured at site for smooth and uninterrupted work of slip form. 24. Operation of slip form method of construction is a continuous one and it demands continuous/intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity. 25. While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety Engineer. 26. For smooth and unhindered supply of concrete, while the slip form is in operation, it is desired that batching plant for concrete of chimney shell be placed in close proximity of chimney shell. However, all the safety measures required for placing batching plant close to shell must be ensured. Safety measures as listed below must be adhered to but should not be limited to only these: a) Safety helmets and belts to be provided to all supervising staff and workers. b) Safety nets to be provided below both inside and outside platforms as instructed by Engineer. c) Hand railing and toe guard to be provided around all openings and platforms. d) Regular maintenance of equipment, checking of hoists, scaffoldings etc. e) Passenger hoist must have multiple ropes with adequate factor of safety. f) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure Emergency standby generator must be kept ready during the entire period of slipform method of construction.			

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 31 of 41	

g) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

26. Permissible construction tolerances should be limited to the following:

Variation in wall thickness	:	(-) 5 mm, (+) 25 mm
Variation from Design Diameter	:	($\pm$) 25 mm or ($\pm$) 2.5 mm per 3 m dia. whichever is larger, but in no case more than ($\pm$) 5 mm.
Out of Plumb in General	:	1 in 1000 of height subject to a maximum of 200 mm.

3.4.0 Steel Flues

3.4.1 General

Fabrication and erection of Steel Flues shall conform to "Technical Specification for Fabrication and Erection of Structural Steelworks" furnished in this Specification.

3.4.2 Fabrication

Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. No smithy process shall be adopted for the purpose. Plates are to be prevented from distorting by more than the tolerances specified during transportation, storage, handling, erection and jointing. All components should be correctly located and brought into correct alignment and level within specified erection tolerances, before adjacent pieces are jointed or secured.

3.4.3 Assembly

Each flue would be assembled from its Component "Cans" near to ground level within the wind-shield. Incomplete flue would be hung only from the flue support platform during assembly, and progressively hoisted to enable connection of further cans at its lower end. Upon completion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floor as indicated in the drawing. It is envisaged that each flue will be assembled and hoisted in three sectional lengths; site joints between sectional length being located just above a steel floor level.

Joints between individual cans should be flanged and bolted on outside and to have sealed welded joints on inside in accordance with clause 3.3.0 - "Welded Construction" under Technical Specifications" for Fabrication of

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 32 of 41	

structural steel work. The Contractor shall submit a drawing showing proposals for erection and indicating locations of all site joints which should be kept to minimum.

3.4.4 Flue Expansion Compensator

For installation of Expansion Compensators, the manufacturer's instruction should form the basis of the Contractor's method. This method, in a statement, should be submitted to the Engineer for approval. Once approved it has to be followed throughout the installation sequence. Expansion Compensators should be prevented from distortion during transportation, handling, erection and jointing, by more stringent tolerances than specified by the manufacturer.

3.4.5 Tolerances

Permissible tolerances in the fabrication and erection of steel flues are given below :

- a) Internal diameter shall not vary by more than : $\pm 12 \text{ mm}$
- b) Centre of any section shall not be eccentric from vertical centre line by more than : 10 mm in any 15 metre height
- c) Centre of any section at height 'h' is in mm. above GL shall : $(h/2500 + 10) \text{ mm}$, not be vertical centre where line by more than
- d) Local deviation from a true circular form should not exceed the shell thickness (Measurement should be made from a segmental circular template having radius of flue shown in drawing and a chord length equal to 0.15 of that radius).
- e) Peaking or stepping at welded horizontal seams shall not exceed 4 mm. (Measurement shall be made with a straight edged template long enough to contact the straight shell on either side of the peaked area).

3.4.6 Erection

Erection of Steel Flues and C.I. Chimney caps shall be done as per requirement of IS:800.

The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 33 of 41	

provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.

3.5.0 Insulation and Protective Treatment

3.5.1 Acid and Heat Resistant Paint

Top 15 meters of the outside face of R.C.C. windshield horizontal surface at the top of windshield and inside face from the top of the windshield to the top of roof slab or as specified in the drawing shall receive a protective treatment of three coats of acid and heat resistant black paint. The quality and type of the paint shall have the prior approval of the Engineer. For this, a small area shall be painted and a sample of paint shall be shown to the Engineer.

The surface to be painted shall be prepared and primary coat, if required as per the paint manufacturer's specification and direction of the Engineer, shall be applied. The paint shall conform, unless otherwise stated, to the requirement of IS:158. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for his approval. The surface to be painted shall be completely dry before the paint is applied and the drying time between consecutive coats shall not be less than 5 hours. The overall combined thickness of paint shall be a minimum of 230 microns.

3.5.2 Cement Paint

The outside face of the Chimney shell, unless specified otherwise, shall be painted with Cement water proof paint. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any unevenness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Contractor shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS:5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.

3.5.3 Insulation and Packing

All insulation material should be of dimension and type, shown in the drawing. Load bearing insulations at supports and side restraints of Steel liners should be an assembly of M.S. Plates, Stainless Steel Plates, PTFE (Poly Tetra Fluoro Ethylene) sheets and or/asbestos fibre reinforced boards (SINDANYO BLOCKS). Insulation to be fixed on outer surface of steel flues should be made of glass or mineral wool.

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 34 of 41	

a) **Load Bearing Insulation Block**

Load bearing assembly should consist of three units and be fabricated according to approved drawings. It would be fabricated from mild steel units with a stainless steel sheet bearing plate and load bearing insulation blocks as indicated in drawing.

The first unit is bolted to the supporting beam. It consists of a M.S. base plate with bolt holes on which a machined M.S. plate is welded. This plate is provided with recess for PTFE sheet (conforming to BS : 5400) to seat, being lubricated with silicon grease.

The second unit also consists of a M.S. plate having adequate size & thickness as shown in drawing. While one surface of the plate is provided with a stainless steel bearing plate the other surface has a thin layer of lead/ elastomeric sheet. The side having stainless steel surface is placed on PTFE surface of First unit.

The third unit consists of two layers of load bearing insulation blocks each having a minimum thickness of 50 mm and factory bonded to top & bottom M.S. plates. These are separated by 100 mm. long load bearing insulation dowels as shown in the drawing. These plates are in turn welded to two additional M.S. plates. Of the two surfaces thus created one shall be welded to bracket assembly while the other should rest on the lead sheet of second unit. Bearing assembly, thus formed, should be levelled by using suitable M.S. shims.

Support arrangement typically consists of flue support shoe (a part of flue), flue support bracket connected to the shoe by precision bolted connection. The bracket in turn is welded to the bearing assembly, which in turn is bolted to available supporting beams.

Support brackets and bearing assembly are welded to locally thickened area of flue. These support the flue on support platform at suitable locations indicated on the drawing.

The arrangement described above should cater for easy and smooth thermal movements of linear element. Suitable restraint brackets and M.S. stop plates need be provided as shown in drawings to prevent excessive movement and thus keeping different units of bearing assembly in proper position.

b) **Insulation Block at Lateral Restraints**

At flue restraint platforms, necessary restraint arrangement with load bearing insulation blocks and stainless steel bearing plates fixed to the insulation blocks should be provided as indicated in drawings.

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 35 of 41	

Restraint and support brackets need be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements.

c) **Glass or Mineral Wool**

Insulation thickness of 65 mm as is specified in clause 2.05.10 shall be built up using two (2) layers composed of 40mm and 25 mm thick insulation blocks. Thicker layer shall be put as first layer around the flue on its exterior surface.

The insulation on the flue shall be fixed using chicken G.I. wire mesh, G.I. wire ties, insulation retaining studs, washers etc. All joints shall be staggered. The insulation shall be tightly secured to the exterior surface of the flue by impaling on the studs and fixing in place by means of 63mm round or square metal plated speed washers. 20 gauge galvanized wire netting shall be wrapped continuously over the entire exterior of insulation. The wire mesh shall be 25mm hexagonal pattern conforming to IS:1566. All joints in the mesh shall be tapped a minimum of 150 mm tied by 16 gauge soft annealed wire at 300 mm spacings. Lacing at joints shall not be used. The Contractor before application of insulation, shall take prior approval of actual fixing arrangement from the Engineer.

The insulation shall be able to sustain structural vibrations and shall not settle under such conditions during erection, construction & operation. The insulation shall be suitably tied to prevent dislocation under adverse conditions.

The cladding of stainless steel sheet over the insulation shall be well secured using pins, fasteners etc.

d) **Vermiculite Concrete**

Vermiculite concrete shall be made by mixing exfoliated vermiculite, portland cement and water. It shall be of Grade-B, having a density of 210 Kg./Cu.M. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1 cement and 8 vermiculite by volume.

3.6.0

Acid-Proof/Chemical Resistant Protection to Roof Slab

Acid-Proof/Chemical Resistant tiles bedded on acid proof/chemical resistant mortar shall be provided for the protection of roof slab. The intervening space between the tiles shall also be filled up by chemical resistant/acid-proof epoxy mortar grouts. The mortar shall be used immediately after mixing.

Tiles shall be made of clay, feldspar or quartz and vitrified at a high temperature in ceramic kilns. These should be unglazed, free from

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002		
		VOLUME - IIB		
		SECTION - D	SUB SECTION- D25	
		REV. 0	DATE	09/12/2019
		SHEET 36 of 41		
deleterious materials and should conform to IS:4457. Iron oxide in the raw materials used, shall not exceed 2 percent. They should show a fine grained, dense and homogenous fracture when broken. They shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimensions of the tiles shall be 198.5 x 198.5 x 35 mm. Depth of the groove on the underside shall not be more than 3 mm. Compressive and tensile strengths of the tiles shall not be less than 70 N/Sq.mm and 3.5 N/Sq.mm respectively.				
3.7.0	Flue Acid Drains and Manholes			
Flue acid drainage system, where provided, will comprise of collection sumps, dilution manholes, conveying pipes including connection to main drainage system.				
Stainless steel pipes, bends, collection sumps, fixing straps, bolts etc. conforming to the relevant Indian Standards (or in absence of which British Standard BS:3605) shall be used in work. Pipes should be cut and joined as per manufacturer's instructions so as to leave the surface clean and square to the axis of pipe.				
Manhole should be constructed as per drawing. However, for general guidance it may be noted that pit of required dimensions should be excavated, lean concrete (1:2:4 mix) of required thickness to be laid, Acid-proof/Chemical resistant brick masonry in 1:4 acid resistant cement mortar of necessary thickness be built and both sides plastered by 12mm thick acid proof plaster (1:3 mix) having waterproof admixtures.				
Manholes should be covered by reinforced concrete slab on which a heavy duty (HD) manhole cover with frame having diameter 560mm and total weight 255 Kg (140 Kg for manhole and 115 Kg for cover) is to be fixed. For additional safety another inner cover or other approved methods may be adopted. The manhole cover shall be distinctively coded to indicate the type of drainage involved.				
Inside manholes necessary channels and benchings finished smooth by neat cement in cement concrete (1:2:4) and foot rungs made from 20mm round bars at 300mm centres and staggered should be provided. Rungs should project 100mm from wall face and be embedded 200mm inside cement concrete block made in that location of brick work. These foot rests shall be painted with coal tar in the projected portions and cement slurry in the embedded part. Joint of any pipe with brick work shall be rendered perfectly leak proof.				
Pipes and fittings in the connection pipe to the main drainage system shall be vitrified clayware conforming to relevant IS and laid to the line and level indicated in the drawings.				
3.8.0	Roof Drainage			
3.8.1	General			



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D25

REV. 0

DATE 09/12/2019

SHEET 37 of 41

Rainwater outlets and down comers to run along inner face of stack wall, shall be made of standard cast iron rainwater pipes conforming to IS:1230. The brackets used to hold the pipes alongside the walls shall be wrought iron clevis type, split ring type or of perforated strap iron as approved by the Engineer. Each vertical pipe shall hang freely on its bracket fixed just below the socket. Suitable spacer blocks are to be kept in between the pipe and wall surface for fixing the pipe. All bends and junctions shall be provided with water tight clean-outs.

3.8.2

Pipe Joints

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water tight when under ground. Method of pipe cutting and jointing shall be as per instruction of the pipe and fittings manufacturer or as approved by the Engineer. However following guidelines may be followed in absence of any instruction available from the manufacturer.

Socket and Spigot pipes shall be joined by cast lead joints. Spigot of the following pipe should be centred in the socket of the preceding pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. After the gasket or hemp yarn has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent air lock. Molten lead shall then be placed round the barrel and tightened against the face of the socket. Thereafter molten lead should be poured in to fill the remainder of the socket and caulked with suitable tools tight round the joint to make up for shrinkage of the molten metal on cooling and should be finished 3mm behind the socket face. If any joint is suspected to be damaged it has to be opened out & redone. Joints in cast iron pipes with special jointing arrangements like "Tyton" joints etc. shall follow the instructions of the manufacturer.

4.0.0

TESTING AND ACCEPTANCE CRITERIA

4.1.0

General

The Contractor shall carry out all sampling and testing in accordance with the relevant IS Specifications and as supplemented herein, for the following items or any other item as may be required by the Engineer unless otherwise specified in this specification. The Contractor shall get the specimens tested in laboratory, approved by the Engineer and shall submit to him, the original test results in triplicate, within seven days after the completion of the test. Engineer may present himself while such tests are being carried out.

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 38 of 41	
4.2.0	Cement	Representative samples shall be taken as per the relevant IS Specification from each consignment of Cement received from the Purchaser/Manufacturer/Supplier for carrying out the tests for fineness (by hand sieving), setting time, compressive strength and soundness tests, and the Contractor shall carry out the above tests as per relevant Indian Standard. If the cement is supplied by the Contractor the test shall be carried out by him. The Contractor shall carry out any or all the tests on aggregates as may be required by the Engineer, in accordance with IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant IS specifications.	
4.3.0	Water	Sampling and testing of water being used for concrete works shall be carried out as per IS:3550, by the Contractor, at regular intervals and whenever directed by the Engineer. The final acceptance criterion in case of doubt shall be as per IS:3025.	
4.4.0	Concrete	The Contractor shall take cubes for works test as per requirement laid down in IS:516 regularly from the day's pour. The number of test cubes to be taken shall be as per IS:456. The Engineer may also use his discretion in deciding the rate of cubes to be taken. The acceptance criteria is to meet the requirement of IS:456. If the cube test results indicate that some portions of the work is below the required strength, the Engineer may order demolition of that portion of work which is below strength and ask the Contractor to rebuild, provided a satisfactory method of load testing is not possible. Such testing or demolishing and rebuilding shall be carried out by the Contractor.	
4.5.0	Steel Flue	All site and shop welded joints shall be inspected and tested in accordance with clause 4.00.00 of Technical specification for Fab. and Erection of structural steel work.	
4.6.0	Insulations	The insulating materials shall be tested for its stipulated characteristics and properties in accordance with the latest editions of IS:3144 and IS:3346 and/or as directed by the Engineer.	

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-620-C002	
	RCC STACK	VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 39 of 41	

5.0.0

INFORMATION TO BE SUBMITTED

5.1.0

With Tender

The following technical information are required with the tender:

a)

Source and arrangement of processing of aggregates proposed to be adopted.

b)

Type of plant and equipment proposed to be used.

c)

Names of firms with which association is sought for to execute the special items of work e.g. flue expansion compensator, load bearing insulation blocks etc. in the contract.

d)

Types of formwork proposed to be used. All details as per clause no. 3.03.06 to be submitted, if slip form method is proposed to be used.

e)

Shop proposed for fabrication of steel (flue) liners. Detailed write-up on procedure of erection of complete liner system including details of equipment proposed for the same.

f)

For insulating material tests to be offered for inspection & tests for which test certificates will be submitted. A drawing showing the details of fixing insulation on the flues at bearings, lateral restraints and exterior surface.

g)

Proposal for lifting of men and material in constructing the chimney.

5.2.0

After Award

The following information and data including samples where necessary, shall be submitted by the Contractor, progressively during the execution of the Contract.

5.2.1

Programme of Execution and requirement of Materials

Within 30 days of the award of the Contract, the Contractor will submit a Master Programme for completion of the work giving monthwise requirement of materials, particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms & conditions of the Contract. In case the Contractor proposes to take on hire any

 Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 40 of 41	
machinery or tools and plants from the Owner, the detailed phased out programme of such hire is also to be submitted. The master programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work. Detailed day to day programme of every month is to be submitted by the Contractor before the commencement of the month.			
5.2.2	Samples	Samples of all materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities, for approval. All samples shall be submitted well in advance of starting work at site. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying material of specified quality.	
5.2.3	Design Mix	Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work. Further, the mix design for concrete of shell to be validated from a third party agency of national repute, as agreed upon by the owner.	
5.2.4	Detail Drawings	Following items shall be provided by the Contractor which are to be approved by the Owner and Consultant. a) Detail drawings and designs of form work including scaffolding to be used. If slipform method of construction is adopted, then detail drawings showing all the arrangements for slipform technique including methods for reducing internal diameter and providing required slopes on outer diameter. b) Detail drawings and bar bending schedules for concrete components. c) Shop drawings for structural steel and metal work, including inserts etc. The Contractor shall submit his proposal for testing site and shop joints provided in steel members.	

 BHEL Maharatna Company	TITLE: RCC STACK	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D25
		REV. 0	DATE 09/12/2019
		SHEET 41 of 41	

- d) Detail drawings for templates and temporary supports for embedments.
- e) Category wise requirements of MS, tor and structural steel including GI flats of various sizes for procurement.
- f) Detailed drawings of steel flues indicating details of joints, supports and restraints including insulation blocks, and details of expansion compensator.
- g) Detailed drawing of hoisting arrangement for men and material satisfying statutory regulations laid down for safety purpose.

5.2.5

Reports

Following Test Reports shall be furnished by the Contractor:

- a) Mill Test Report for cement and reinforcing steel if the materials are supplied by the Contractor.
- b) Inspection Report of bought out items.
- c) Inspection Report of formwork and reinforcement, insulations etc.
- d) Reports of tests of various material and concrete.
- e) Radiographic tests on welded joints in steel flues.
- d) Any other data or report or test result required by the relevant IS Specifications and if required by the Engineer for satisfactory quality control of the workmanship.



TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE 19/02/2020

SHEET 1 of 8

VOLUME: II B
SECTION – D
SUB SECTION – D26
BOROSILICATE GLASS BLOCK LINING SYSTEM

SPECIFICATION NO. PE-TS-999-620-C002



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE

19/02/2020

SHEET 2 of 8

Table of Contents

1. Project Description
 - 1.1 Description
 - 1.2 Flue gas characteristics
 - 1.3 General configuration
2. Scope of work
 - 2.1 scope of supply
 - 2.2 Bidder services
3. Special equipment, Tools and Instruments
4. Standard and codes
5. Quality assurance and quality control
6. Safety, Noise and Environment requirements
 - 6.1 Safety
 - 6.2 Environment data
7. Mechanical Technical Requirement
 - 7.1 Design parameters
 - 7.2 Operating conditions
 - 7.3 Performance Requirements
 - 7.4 Design requirements
 - 7.5 Material requirements
8. Handling, Storage and protection
 - 8.1 Facilities
 - 8.2 Storage
9. Job site inspection and preparation

 BHEL Maharatna Company	TITLE: BOROSILICATE GLASS BLOCK LINING SYSTEM	SPECIFICATION NO. PE-TS-999-620-C002	
		VOLUME - IIB	
		SECTION - D	SUB SECTION- D26
		REV. 0	DATE 19/02/2020
		SHEET 3 of 8	

1 PROJECT DESCRIPTION

1.1. Description

This specification covers borosilicate glass block lining system in thermal power plant chimney.

1.2. Flue gas parameters

The chimney shall be working with the flue gas parameters as per Annexure-I.

1.3. General configuration

The Chimney general arrangement configuration shall be as provided elsewhere in the specification. However, during detailed engineering, modification may be done.

2 SCOPE OF WORK

2.1 Work to be provided by the contractor, unless specified otherwise, shall include but shall not limited to following:

2.1.1 Design, preparation of working drawings, material supply, erection, application, Handling, transportation, storage, preservation, pack and furnish with adequate moisture proof packing and test of borosilicate glass block lining system on flue liner substrate including:

- a) Suitable primer, two component suitable adhesive membrane and closed cell borosilicate glass blocks.
- b) Required Surface finish of flue liner substrate as recommended by borosilicate glass block lining system manufacturer/supplier.
- c) Installing borosilicate glass block lining system on flue liner substrate using two component suitable adhesive membrane under controlled temperature and humidity conditions, including skilled labor, material, tools & tackles, equipment required to create controlled temperature & humidity conditions during installation, hot blow cleaning (after priming, if required) of flue liner substrate before application, mixing of two component suitable adhesive membrane by automated mixing machines etc. all complete.
- d) Complete onsite QA and supervision, by borosilicate glass block lining manufacturer/supplier, during surface finish of flue liner substrate, application of primer, application of two components suitable adhesive membrane, installation of borosilicate glass blocks on flue liner substrate

2.1.2 All necessary parts, and works necessary for transport, storage and application purposes.

2.1.3 Submission of the drawings and getting the same approved from BHEL and the project owner.



TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE 19/02/2020

SHEET 4 of 8

- 2.1.4 The contractor shall furnish all design, labor, materials, tools and equipment necessary for the installation of borosilicate lining system, as indicated and specified herein.
- 2.1.5 The Work shall include everything requisite and necessary to finish the job properly, to the satisfaction of engineer in charge, notwithstanding that every item of labor or materials or accessories required to make the installation complete may not be specifically mentioned.
- 2.1.6 The Equipment / material for the Unit shall be supplied complete with provisions for appurtenances and accessories, to form a complete system which will achieve and assure safe and reliable operation with best overall performance.
- 2.1.7 Contractor shall provide, in the required format and form and in a timely manner, all drawings and documentation required by this Specification and/or required by applicable Standards and codes. A consistent nomenclature shall be used project-wide in naming all component parts within the Scope of Work. This shall apply to all drawings, Bill of Materials, special instructions, etc. The cost of correcting inconsistent nomenclature shall be borne by the contractor.
- 2.1.8 Changes in design and drawings already approved by the owner are normally unacceptable. However, should such changes become necessary on an exceptional basis, the contractor shall obtain the owners approval prior to introducing any such change.

2.2 Contractor Services

Field personnel provided by the contractor shall be capable and qualified to perform the required duties to the satisfaction of BHEL and the owner.

3 SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS

Contractor shall provide all special equipment, tools and instruments, skilled manpower required for handling and storage, and for test and maintenance of borosilicate glass block lining system provided under this Contract.

4 STANDARDS AND CODES

4.1 The borosilicate glass block lining system to be provided under this Specification, including all appurtenances and accessories, shall be designed, inspected, tested, stamped and preserved to the extent indicated in said referenced standards and codes. Where this Specification does not include such reference, the system, or any of its components, shall be designed, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or manufacturer's/suppliers specification, whichever is stringent and more restrictive.

4.2 In all cases contractor shall adhere to and comply with the requirements of Indian standards, which are found to be more restrictive than those specified herein.

5 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 The contractor shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.

	TITLE:	SPECIFICATION NO. PE-TS-999-620-C002	
	BOROSILICATE GLASS BLOCK LINING SYSTEM	VOLUME - IIB	
		SECTION - D	SUB SECTION- D26
		REV. 0	DATE 19/02/2020
		SHEET 5 of 8	
5.2 The contractor shall conduct an inspection and testing program which shall record and verify the essential properties of the constituent materials and the finished liner. 5.3 The contractor shall conduct test to verify the mechanical properties of borosilicate glass blocks and two components suitable adhesive membrane and the tests shall be documented during the course of design and shall be made available to owner. 5.4 Unless otherwise specified the contractor, standard tests shall be performed on all batches of materials furnished. The owner may or may not elect to witness tests, but the contractor shall notify the owner in advance of all scheduled tests. 6 SAFETY, NOISE AND ENVIRONMENT REQUIREMENTS 6.1 SAFETY The material and equipment supplied under this specification shall meet the U.S. "OCCUPATION, SAFETY, AND HAZARD ADMINISTRATION" (OSHA) requirements or equivalent. 6.1.1 Jobsite Safety and Scrap Disposal ○ Safety programs and procedures shall be within the scope of this specification. It should be noted that materials that are potentially flammable, must be handled in keeping with good industry practice and in compliance with the manufacturer/supplier recommendations. ○ Proper disposal of scrap and waste materials shall be followed by the contractor as instructed by owner. 6.1.2 Safety and protection of material, work and property: The contractor shall provide for the safety and protection of the work, materials and equipment to be incorporated therein, whether in storage on or off the site. Provide protection at all times against rain, wind, storms, condensation, or heat so as to maintain all work, equipment and materials free from damage. At the end of each day, all new work likely to be damaged shall be appropriately protected. 6.2 Environmental Data 6.2.1 The contractor, upon request shall provide a plan for the treatment of the discharge/waste to meet current regulations of the Indian government/ regulatory authorities. 6.2.2 The contractor, upon request shall provide additional information on noise and/or other environmental data. All information shall be prepared in a manner acceptable to Indian government/ regulatory authorities. 7 TECHNICAL REQUIREMENTS			



TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE 19/02/2020

SHEET 6 of 8

7.1 Design parameters

7.1.1 Liner considerations

The borosilicate glass blocks shall be of suitable thickness as per the scope. Proper provisioning should be made for borosilicate glass block lining system for protection around gas sampling ports, expansion joints, man holes, mini-shell and other appurtenances.

7.2 Performance Requirements

7.2.1 Borosilicate glass block lining system shall be designed in such a way that it will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.

7.2.2 Borosilicate glass block lining system and all of the required components shall be designed for a safe, useful life of thirty (30) years (minimum).

7.2.3 Ten (10) year full replacement guarantee, including supply, erection, enabling works, labor, material (borosilicate glass blocks, two components suitable adhesive membrane, suitable primer), surface preparation, arrangement for application etc. all complete, and fulltime onsite QA supervision during erection & commissioning.

During the guarantee period if the lining system fails to protect the subject surface from deterioration, the contractor shall replace the partially affected portion or complete borosilicate glass block lining system without any additional cost.

7.2.4 The borosilicate glass block lining system shall be offered by a manufacture/supplier with demonstrated capabilities in the area of onsite technical support and QA/QC supervision, who employs QA/QC supervisors with a demonstrated experience in technical support and QA/QC supervision of the subject lining system.

7.2.5 The borosilicate glass block supplied lining system shall be capable of withstanding fire risk for a minimum period of 2 hours as per ASTM E-119 or equivalent codes/standards. Proper certification from an independent institute of sufficient knowledge and experience shall be submitted by supplier subject to acceptance by the project owner, showing the capability of the borosilicate glass block lining to protect the steel chimney flues from structural damage by fire of said rating.

7.2.6 Contractor shall produce certificates from an independent institute of sufficient knowledge and experience, subject to acceptance by the



TITLE:

BOROSILICATE GLASS BLOCK LINING SYSTEM

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE 19/02/2020

SHEET 7 of 8

project owner, showing that the workers can do the work on supplied lining system safely, without any adverse health effects and without requiring excessive protective measures.

7.3 Design Requirements

7.3.1 General

- Design of the borosilicate lining system must be performed by a professional engineer in the design of such system for thermal power plant chimneys.
- Requirements of this specification are to be regarded as minimum requirements. If the manufacturer/supplier design and/or experience dictate these minimum requirements should be exceeded, the design, supply and application shall be performed accordingly, without any extra cost implication.

7.4 Materials Requirements

The flue liner substrate shall be internally protected with borosilicate glass block lining system consisting closed cell borosilicate glass blocks, two components suitable adhesive membrane and suitable epoxy primer meeting all of the following requirements:

7.4.1 The borosilicate glass block lining system shall use closed cell borosilicate glass blocks with the following properties:

- a. Density of $0.19 \times 10^3 \text{ kg/m}^3$ (+/- 20%).
- b. Coefficient of linear thermal expansion not greater than $5.7 \times 10^{-6}/^\circ\text{C}$.
- c. Min. compressive strength of 1.00Mpa as per ASTM C165/C240.
- d. Minimum flexural strength of 0.62 Mpa as per ASTM C203/C240.
- e. The blocks shall be resistant to thermal cyclic loading under FGD bypass/ hot gas service conditions, and sudden temperature changes, including high temperature spikes.

7.4.2 The borosilicate glass block system shall use a flexible, chemically resistant adhesive, with all required surface preparation, primer, labor, equipment etc., all complete. The adhesive membrane shall be a 2-component having excellent elastomeric properties and be acid & heat resistant. The adhesive membrane shall be applied in between and behind the blocks in a minimum 3 mm thick layer ensuring a proper bond and adhesion. The adhesive membrane shall have the following properties.

- a. Minimum tensile strength at 23 °C of 1.0 N/mm² as per ASTM D412
- b. Resistant to corrosive flue gas environments.
- c. Remain elastomeric and flexible under hot gas conditions and sudden temperature changes.
- d. The adhesive shall be suitable for trowel application.



TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM**

SPECIFICATION NO. PE-TS-999-620-C002

VOLUME - IIB

SECTION - D

SUB SECTION- D26

REV. 0

DATE 19/02/2020

SHEET 8 of 8

- 7.4.3 The steel substrate shall be grit blasted to a cleanliness of SA 2 1/2 and approved by the manufacturer/supplier of the borosilicate glass block lining system. The substrate shall thereafter be primed using a high performance epoxy primer within a short time window approved by the manufacturer/supplier. The lining system manufacturer/supplier shall demonstrate a proven Quality Control system that monitors and documents the key physical properties, as described above.

8 HANDLING, STORAGE AND PROTECTION

8.1 Facilities

- 8.1.1 Contractor shall construct adequate facilities for the storage of material. Upon completion of fabrication, the contractor shall remove the fabrication facility from the site and return the area to the pre-construction condition.
- 8.1.2 The installation of borosilicate lining system must be done in a suitable environment (temperature, humidity etc. control as per manufacturer recommendation to stand by the required guarantee). Maintenance of the required suitable condition and any tools/tackles, machinery required to maintain the controlled environment during installation of borosilicate glass block shall be in the scope of contractor.

8.2 Storage

- 8.2.1 Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the manufacturer/supplier. Do not allow shelf-life limits, as determined by the manufacturer/supplier, to be exceeded.
- 8.2.2 Materials surfaces shall be protected from dust, fog, rain and other contaminants.
- 8.2.3 Affected materials shall be removed if any of the above requirements are not met.

9 JOB SITE INSPECTION AND PREPARATION

- 9.1 In coordination with the chimney contractor the borosilicate glass block lining system installation agency should submit a plan detailing the application sequence and methods to be employed, including moving, handling, storage, erection, fit up and the methods to be used for environmental protection.

Date: 02.04.2020

BHEL/PEM/MSE
2x250MW BHILAI-FGD SYSTEM

NTPC L.R.N.: null109:93 DTD. 09.03.2020

Our point wise reply to NTPC comments received above mentioned l.r.n are as:

S.no.	NTPC Comments	BHEL Replies
1	Comment marked.	Marked up comments are replied below.
i)	May please provide calculation to avoid further revision.	As already clarified that the calculation is the output of the software calculation. Net draft in the chimney is the difference of draft created and the losses in the chimney. Draft created is the result of density difference of ambient air and the flue gas while the losses are due to pressure drop in the chimney corresponding to flue gas velocity. Please also note that the sizing calculation is submitted in line with recently approved chimney sizing calculation of 3x660MW North Karanpura FGD project.

With above replies, Chimney sizing is resubmitted for NTPC approval.

Encl.:

1. Chimney Sizing Calculation -R00

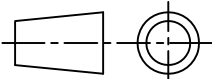
COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
it must not be used directly or indirectly in any way detrimental to the interest of the company

REV	DATE	ALTERED	REV	DATE	ALTERED	
		CHECKED			CHECKED	
		APPROVED			APPROVED	
						JOB NO. 468

NTPC-SAIL POWER COMPANY LIMITED

NSPCL-2X250MW BHILAI TPP-FGD(LOT 2)

NTPC DOC.NO: 9993-109-PVM-B-306

REF.DRG. NO.			BHARAT HEAVY ELECTRICALS LIMITED PROJECTS ENGINEERING MANAGEMENT, NEW DELHI							
	DEPT. M	CODE 20		SCALE NTS	WEIGHT(KG) -	REF TO ASSY DRG. -		ITEM -		
	CHIMNEY SIZING CALCULATION						NAME	SIGN	DATE	
						PREP.	VK		06.02.2020	
CHECKED						CM		06.02.2020		
						APPD.	CM		06.02.2020	
CDV500	DEPT.						CARD CODE -	DRAWING NOS.		REV 00
	SIGN			N.A.				PE-DC-468-100-N117		
	DATE							NO. OF SHEETS 2		

2x250MW BHILAI-FGD SYSTEM**CHIMNEY FLUE ID CALCULATION WITH SINGLE FLUE CAN & BOROSILICATE LINER**

Parameter	Units	Design Point-VWO	Guarantee Point-TMCR
Flue gas quantity per boiler	T/Hr	1568.18	1391.66
Temp. of flue gas at stack inlet	°C	61.1	57.2
Flue gas density at stack inlet	Kg/m ³	1.01246	1.03965
Volumetric flow per boiler	M ³ /s	430.24	371.83
Stack Height	M	150	150
Breeching level	M	32.3	32.3
Ambient air temp.	°C	45	27
Relative Humidity	%	60	60
Effective Stack Height	M	117.7	117.7
Draft created	mmWC	4.30	10.35
Internal flue dia	M	5.1	5.1
Flue gas velocity at stack exit	m/sec	21.05	18.19
Total Loss	mmWC	32.90	25.24
Net draft available	mmWC	-28.60	-14.89
Minimum Flue gas pressure required at Chimney inlet for positive draft	mmWC	29.00	15.00
Selected Flue gas pressure required at Chimney inlet for positive draft	mmWC	30.00	

Reference: 1. NTPC Doc. No.: 9993-109-PVM-W-002

2. Technical Specification Cl. 3.00.00A & Cl. 4.01.08 of Section-VI, Part-A & Sub Section -V