



TITLE: KAHALGAON- ST I & II (4X210 MW + 3X500 MW) FGD

SPECIFICATIONS FOR RCC CHIMNEY

SPECIFICATION NO. PE-TS-481-620-C002

VOLUME : IIB

SECTION : C

REV.NO. 00

SHEET

KAHALGAON- ST I & II (4X210 MW + 3X500 MW) **FGD SYSTEM PACKAGE**

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION-C **SPECIFIC TECHNICAL REQUIREMENTS** **(RCC CHIMNEY)**

SPECIFICATION NO. PE-TS-481-620-C002
REV-00



Bharat Heavy Electricals Limited

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

 Maharatna Company	TITLE: KAHALGAON- ST I & II (4X210 MW + 3X500 MW) FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-481-620-C002
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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.

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SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS (RCC CHIMNEY)

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
1.00.00	BACKGROUND Kahalgaon Super Thermal Power Station, KhSTPP was conceived as a Load Centre coal based Power Station of 1000 MW capacity by NTPC. The land for the project was acquired and Stage-I (4x210 MW) was implemented by NTPC. Thereafter, NTPC implemented Stage-II Phase –I (2x500 MW) and Stage-II Phase-2 (1x500 MW). Hence, the present capacity of the plant is 2340 MW.			
1.01.00	LOCATION AND APPROACH The plant is located in Bhagalpur district of Bihar, having latitude and longitude of 25° 15''N and 87°15E respectively. Bhagalpur town is located at a distance of about 30 kms from the plant. Colgong (Kahalgaon) railway station on Patna Kolkatta broad (BG) section of Eastern Railway (NR) is 2 kms away. The nearest airport is located at Patna at a distance of approximately 250 km from the project site.			
1.02.00	LAND A total area of about 3360 acres of land has been acquired for the project in Stage-I. The Stage-II Phase I & Phase –II is also located in the existing area as no additional land is acquired for these stages.			
1.03.00	WATER The project is located near river Ganges. The make up water requirement for the plant is proposed to be drawn from river Ganges. As per agreement between NTPC & Irrigation department, 180 Cusec (drawl) and 80 cusec (consumptive) water for both the stages of the project is available.			
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 is CW Blowdown based on the COC indicated 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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-II-A3 PROJECT INFORMATION KHSTPP-I& II	PAGE 1 OF 33

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
2.00.00	NOT USED			
3.00.00	Capacity Stage-I 4 x 210 MW Stage-II 2 x 500 MW PHASE-I Stage-II 1 x 500 MW PHASE-II			
4.00.00	Metrological Data Not Used			
5.00.00	Criteria for Earthquake Resistant Design of Structures and Equipment All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration ‘g’) in the horizontal direction for 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).			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-II-A3 PROJECT INFORMATION KHSTPP-I& II	PAGE 2 OF 33

CLAUSE NO.	PROJECT INFORMATION 																		
	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)</td><td>Steel structures</td><td>:</td><td>2%</td></tr> <tr> <td>b)</td><td>Reinforced Concrete structures</td><td>:</td><td>5%</td></tr> <tr> <td>c)</td><td>Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr> <tr> <td>d)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr> </table>			a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%
a)	Steel structures	:	2%																
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LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-II-A3 PROJECT INFORMATION KHSTPP-I& II	PAGE 3 OF 33																

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
	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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-II-A3 PROJECT INFORMATION KHSTPP-I& II	PAGE 4 OF 33

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
	APPENDIX – I SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration : 0.28g 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 : 0.07 b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.053 c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.042 d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.14 e) For Liquid retaining tanks : 0.084 f) for Steel chimney, Absorber tower, Vessels : 0.105 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) : 0.07 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 : 0.14 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.			
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ANNEXURE-A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS
In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
0.000	1.000	1.000	1.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000	1.000	1.000	1.000
0.050	1.796	1.760	1.686	1.626	1.537	1.416
0.050	1.796	1.760	1.686	1.626	1.537	1.416
0.100	3.974	3.792	3.427	3.146	2.753	2.270
0.100	3.974	3.792	3.427	3.146	2.753	2.270
0.119	4.842	4.597	4.094	3.713	3.186	2.556
0.120	4.842	4.627	4.130	3.742	3.209	2.570
0.122	4.842	4.627	4.206	3.802	3.254	2.600
0.125	4.842	4.627	4.206	3.879	3.321	2.643
0.129	4.842	4.627	4.206	3.879	3.340	2.700
0.134	4.842	4.627	4.206	3.879	3.340	2.776
0.150	4.842	4.627	4.206	3.879	3.340	2.776
0.200	4.842	4.627	4.206	3.879	3.340	2.776
0.250	4.842	4.627	4.206	3.879	3.340	2.776
0.300	4.842	4.627	4.206	3.879	3.340	2.776
0.350	4.842	4.627	4.206	3.879	3.340	2.776
0.400	4.842	4.627	4.206	3.879	3.340	2.776
0.450	4.842	4.627	4.206	3.879	3.340	2.776
0.500	4.842	4.627	4.206	3.879	3.340	2.776
0.550	4.842	4.627	4.206	3.879	3.340	2.776
0.594	4.842	4.627	4.206	3.879	3.340	2.776
0.598	4.806	4.627	4.206	3.879	3.340	2.776
0.600	4.793	4.615	4.206	3.879	3.340	2.776
0.611	4.707	4.532	4.205	3.879	3.340	2.776
0.632	4.551	4.381	4.065	3.878	3.340	2.776
0.654	4.395	4.231	3.926	3.745	3.340	2.776
0.671	4.286	4.127	3.829	3.653	3.258	2.776
0.700	4.109	3.956	3.670	3.501	3.123	2.661
0.750	3.835	3.692	3.425	3.268	2.915	2.484
0.800	3.595	3.461	3.211	3.064	2.733	2.329

ANNEXURE-A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS
In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
0.850	3.384	3.258	3.022	2.884	2.572	2.192
0.900	3.196	3.077	2.854	2.723	2.429	2.070
0.950	3.027	2.915	2.704	2.580	2.301	1.961
1.000	2.876	2.769	2.569	2.451	2.186	1.863
1.050	2.739	2.637	2.447	2.334	2.082	1.774
1.100	2.615	2.517	2.335	2.228	1.987	1.694
1.150	2.501	2.408	2.234	2.131	1.901	1.620
1.200	2.397	2.308	2.141	2.043	1.822	1.553
1.250	2.301	2.215	2.055	1.961	1.749	1.490
1.300	2.212	2.130	1.976	1.885	1.682	1.433
1.350	2.130	2.051	1.903	1.816	1.619	1.380
1.400	2.054	1.978	1.835	1.751	1.561	1.331
1.450	1.983	1.910	1.772	1.690	1.508	1.285
1.500	1.917	1.846	1.713	1.634	1.457	1.242
1.550	1.855	1.786	1.657	1.581	1.410	1.202
1.600	1.798	1.731	1.606	1.532	1.366	1.164
1.650	1.743	1.678	1.557	1.485	1.325	1.129
1.700	1.692	1.629	1.511	1.442	1.286	1.096
1.750	1.643	1.582	1.468	1.401	1.249	1.065
1.800	1.598	1.538	1.427	1.362	1.214	1.035
1.850	1.555	1.497	1.389	1.325	1.182	1.007
1.900	1.514	1.457	1.352	1.290	1.151	0.981
1.950	1.475	1.420	1.317	1.257	1.121	0.955
2.000	1.438	1.385	1.285	1.226	1.093	0.932
2.050	1.403	1.351	1.253	1.196	1.066	0.909
2.100	1.370	1.319	1.223	1.167	1.041	0.887
2.150	1.338	1.288	1.195	1.140	1.017	0.867
2.200	1.307	1.259	1.168	1.114	0.994	0.847
2.250	1.278	1.231	1.142	1.089	0.972	0.828
2.300	1.250	1.204	1.117	1.066	0.950	0.810
2.350	1.224	1.178	1.093	1.043	0.930	0.793
2.400	1.198	1.154	1.070	1.021	0.911	0.776

ANNEXURE-A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS
In units of 'g' for KAHALGAON STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.50%	2%	3%	5%
2.450	1.174	1.130	1.049	1.000	0.892	0.760
2.500	1.150	1.108	1.028	0.980	0.874	0.745
2.550	1.128	1.086	1.007	0.961	0.857	0.731
2.600	1.106	1.065	0.988	0.943	0.841	0.717
2.650	1.085	1.045	0.969	0.925	0.825	0.703
2.700	1.065	1.026	0.951	0.908	0.810	0.690
2.750	1.046	1.007	0.934	0.891	0.795	0.677
2.800	1.027	0.989	0.918	0.875	0.781	0.665
2.850	1.009	0.972	0.901	0.860	0.767	0.654
2.900	0.992	0.955	0.886	0.845	0.754	0.642
2.950	0.975	0.939	0.871	0.831	0.741	0.632
3.000	0.959	0.923	0.856	0.817	0.729	0.621
3.050	0.943	0.908	0.842	0.804	0.717	0.611
3.100	0.928	0.893	0.829	0.791	0.705	0.601
3.150	0.913	0.879	0.816	0.778	0.694	0.591
3.200	0.899	0.865	0.803	0.766	0.683	0.582
3.250	0.885	0.852	0.790	0.754	0.673	0.573
3.300	0.872	0.839	0.778	0.743	0.662	0.565
3.350	0.859	0.827	0.767	0.732	0.653	0.556
3.400	0.846	0.814	0.756	0.721	0.643	0.548
3.450	0.834	0.803	0.745	0.710	0.634	0.540
3.500	0.822	0.791	0.734	0.700	0.625	0.532
3.550	0.810	0.780	0.724	0.690	0.616	0.525
3.600	0.799	0.769	0.714	0.681	0.607	0.518
3.650	0.788	0.759	0.704	0.672	0.599	0.510
3.700	0.777	0.748	0.694	0.662	0.591	0.504
3.750	0.767	0.738	0.685	0.654	0.583	0.497
3.800	0.757	0.729	0.676	0.645	0.575	0.490
3.850	0.747	0.717	0.666	0.637	0.568	0.484
3.900	0.737	0.699	0.649	0.628	0.561	0.478
3.950	0.728	0.681	0.633	0.604	0.553	0.472
4.000	0.719	0.664	0.617	0.589	0.547	0.466

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC												
6.00.00	<u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u> All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>:</td><td>1.0%</td></tr><tr><td>b) Bolted steel structures/RCC structures</td><td>:</td><td>2.0%</td></tr><tr><td>c) Prestressed concrete structures</td><td>:</td><td>1.6%</td></tr><tr><td>d) Steel stacks</td><td>:</td><td>As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>				a) Welded steel structures	:	1.0%	b) Bolted steel structures/RCC structures	:	2.0%	c) Prestressed concrete structures	:	1.6%	d) Steel stacks	:	As per IS:6533 & CICIND Model Code whichever is more critical.
a) Welded steel structures	:	1.0%														
b) Bolted steel structures/RCC structures	:	2.0%														
c) Prestressed concrete structures	:	1.6%														
d) Steel stacks	:	As per IS:6533 & CICIND Model Code whichever is more critical.														
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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 : 47 metres/second b) The risk coefficient “K₁” : 1.07 c) Category of terrain : Category-2 7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA 7.00.01 Employer had carried out geotechnical investigation in the vicinity of proposed structures during the plant construction stage. The available boreholes in the vicinity of proposed structures are enclosed at Annexure-IV. The provided soil data is limited and the proposed foundation system is with the best efforts based on the available data. The onus of correct assessment / interpretation and understanding of the existing subsoil condition is on the Bidder. Owner is not responsible for any variation in the provided soil data and foundation system. 7.00.02 The available soil data is of the vicinity of the 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 furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data provided by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable			
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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.			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/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. 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.			
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7.02.02	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. For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 2. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.			
	Open Foundations In case open foundations are adopted, following shall be adhered to. a) The minimum width of foundation shall be 1.0 m. b) Minimum depth of foundation shall be 1.0m below Ground Level. c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level. e) During detailed engineering, the allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. In case any loose/soft pockets in rocky strata is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8). f) For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:			
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7.02.03	<table><tr><td>Isolated & Raft (machine foundation)</td><td>25 mm</td></tr><tr><td>Isolated & Strip (other than machine foundation)</td><td>40 mm</td></tr><tr><td>Raft (other than machine foundation)</td><td>75 mm</td></tr><tr><td>Foundations in Weathered rock / rock</td><td>12 mm</td></tr></table>				Isolated & Raft (machine foundation)	25 mm	Isolated & Strip (other than machine foundation)	40 mm	Raft (other than machine foundation)	75 mm	Foundations in Weathered rock / rock	12 mm
	Isolated & Raft (machine foundation)	25 mm										
	Isolated & Strip (other than machine foundation)	40 mm										
	Raft (other than machine foundation)	75 mm										
	Foundations in Weathered rock / rock	12 mm										
	Pile Foundations –											
	(a.) In case piles are adopted, following shall be adhered to :											
	i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs. However, conventional tripod rig may be allowed in inaccessible areas subject to site specific conditions. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.											
	If required, temporary or permanent MS liner may be provided for piling.											
	ii) The minimum diameter of pile shall be 600 mm. Length of the pile and allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & shall be limited to the values given below:											
<table><tr><td>Pile</td><td>Dia. (mm)</td><td>Vertical compression capacity (T)</td></tr><tr><td rowspan="2">Bored cast-in-situ pile</td><td>600</td><td>140</td></tr><tr><td>760</td><td>250</td></tr></table>				Pile	Dia. (mm)	Vertical compression capacity (T)	Bored cast-in-situ pile	600	140	760	250	
Pile	Dia. (mm)	Vertical compression capacity (T)										
Bored cast-in-situ pile	600	140										
	760	250										
The uplift and lateral load capacity shall be respectively restricted to 35% and 5% of the allowable load capacity in vertical compression.												
However, the pile capacities to be adopted shall be the least of the estimated design values and that obtained from the initial pile load tests.												
iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.												
iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.												
v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.												
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	vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the 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.		
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	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) 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. The procedure to carryout the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.			
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7.03.00 7.03.01 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	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 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).		
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CLAUSE NO.	PROJECT INFORMATION 		
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done 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.		
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7.07.02.04	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. 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			
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CLAUSE NO.	PROJECT INFORMATION				
7.08.00	Geotechnical Investigation Scheme				
	a) Boreholes (Minimum)				
	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 shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.
	2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	
	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.				
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NTPC Limited

(A Government of India Enterprise)



LOT-4 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(4)-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-4 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.		
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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: CS-0011-109(4)-9	PART-B SUB-SECTION-IV-D CIVIL WORKS	PAGE 1 OF 67

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.		
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	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. Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) 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.		
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	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. 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		
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	Where, $F = 1700/1400$ for lime & $1250/900$ for gypsum 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.		
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3.04.00	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. 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 blockwork 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.		
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3.06.00 3.07.00 3.08.00 3.09.00	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. 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. Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (a.) In all M. C. C./ Control buildings 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
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3.10.00	designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is 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.			
	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			
	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.			
	Transformer Foundation 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			
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3.12.02	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 tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations. RCC Firewall shall also be provided between the transformers wherever required. 300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.			
	Fencing Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing			
	3.13.00 Booster Fan Foundation & Mill Foundation Booster Fan foundations and Mill Foundations shall be 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.			
	3.14.00 CHIMNEY			
	3.14.01 Salient Features Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The centre to centre distance between the			
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	proposed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 metres. The chimney shell (windshield) shall be constructed using slip form shuttering. Internal 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		
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3.14.02	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 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.			
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3.14.04	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 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.			
	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.			
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3.14.05	The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.			
	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 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			
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.			
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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. (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. d) The entire external surface of chimneyshell shall be painted with epoxy phenolic coating as specified in (iii)above in alternate bands of 'signal red'and 'bright white' colours.		
3.14.10	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.		
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3.15.00	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		
	Limestone Grinding System building This shall be framed building with R. C. C. roof and floor. Forsteel 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.		
	3.16.00 Gypsum Dewatering Building This shall be framed building with R. C. C. roof and floor. Forsteel 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.		
	4.00.00 Drainage & Water Supply Works		
4.01.00	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.		
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4.02.00	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. 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 sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints. 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		
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	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. 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.		
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5.04.00	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 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.		
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5.06.00	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. 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.			
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5.07.00	The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. 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			
	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 1m 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			
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	(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 roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through staircase. Roof access to all other buildings shall be through cage ladder as per requirement.		
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 150mm thick and shall have minimum 10dia HYSD reinforcement bars placed at200 mm center both ways at top andbottom. In case Bidder opts for steel superstructure 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 structuralsteel beams/ purlins using headed shear anchor studs specified elsewherein the specification. For floors with metaldeck the minimum thickness (150 mm)shall be above the top surface (crest) ofthe metal deck sheet 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		
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	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 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 soling		
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8.00.00	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. 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.		
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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 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 dischargein 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			
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	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><tr><td>b) R. C. C. floors</td><td>500 Kgs. / Sq. M.</td></tr><tr><td>c) Stair and balconies</td><td>500 Kgs. / Sq. M.</td></tr><tr><td>d) Toilet rooms</td><td>200 Kgs. / Sq. M.</td></tr><tr><td>e) Chequered plate floors</td><td>400 Kgs. / Sq. M.</td></tr><tr><td>f) Walkways (including walkways in conveyor galleries)</td><td>300 Kgs. / Sq. M.</td></tr><tr><td>g) Conveyor galleries</td><td>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.</td></tr><tr><td>h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches.</td><td>For class 'AA' loading and checked for class A loading as per IRC standard.</td></tr><tr><td>i) Channels / trenches</td><td>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.</td></tr><tr><td>j) Covers for trenches / channels</td><td>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.</td></tr><tr><td>k) Sumps and tanks and other underground basement type</td><td>In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge</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.	b) R. C. C. floors	500 Kgs. / Sq. M.	c) Stair and balconies	500 Kgs. / Sq. M.	d) Toilet rooms	200 Kgs. / Sq. M.	e) Chequered plate floors	400 Kgs. / Sq. M.	f) Walkways (including walkways in conveyor galleries)	300 Kgs. / Sq. M.	g) Conveyor galleries	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.	h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches.	For class 'AA' loading and checked for class A loading as per IRC standard.	i) Channels / trenches	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.	j) Covers for trenches / channels	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.	k) Sumps and tanks and other underground basement type	In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge
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	structures		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 : i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid). ii) Earth with surcharge outside and no water / liquid inside iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.	
	L) Grating covers/ Precast RCC covers for drains, trench, sump pit in ground floor/paving area.	2500kgs. / sqm As per IRC standard (at road crossing for vehicular traffic.)		
	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			
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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		
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 conveyer gallery/cable gallery crosses		
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	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.											
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.											
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17.21.00	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.			
	a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).			
	b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.			
	17.22.00			
	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.			
17.23.00	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.			
	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.			
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	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.) ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise. iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level. b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance. c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.		
17.27.00	Design of Block Foundation a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied. Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).		
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	b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.			
17.28.00	Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings.			
17.29.00	Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC.			
18.00.00	Coating on RCC water retaining structures (other than drinking water) Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below: 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. 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.			
19.00.00	Fabrication All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Tanks, silos etc. can be brought at site in several pieces and can be joined/welded at site . 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, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be be of suitable type and size depending upon specifications of the parent material, the method of welding 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 250oC - 300oC for one hour and later on cooled in the same oven to 100o C. It shall be transferred to a holding oven maintained at 60oC - 70oC. The electrodes shall be drawn from this oven for use.			
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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 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.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS																			
	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.			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 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																		
	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 submerged arc welding</th><th>Other than low hydrogen electrode</th></tr><tr><td>Upto and including 20mm</td><td>None</td><td>Not Allowed</td></tr><tr><td>Over 20mm</td><td>120oC - 140°C</td><td>Not Allowed</td></tr></table> Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.			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	Not Allowed	Over 20mm	120oC - 140°C	Not Allowed						
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	Not Allowed																		
Over 20mm	120oC - 140°C	Not Allowed																		
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.																			
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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.		
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.		
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24.00.00	CONCRETE		
	All R. C. C. works to be 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. 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.		
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25.02.00	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.		
	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. 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.		
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26.00.00	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 pain 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.			
	CHEMICAL INJECTION GROUTING 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 repercussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.			
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	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. Co - efficient of permeability shall be about 5x10⁻¹⁰ 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.		
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28.04.00	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 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.		
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	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 underbed (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. (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		
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	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 granitestone 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. (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).		
29.05.00	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		
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	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. 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.		
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29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230mm 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.		
29.08.04	Deleted		
29.09.00	Internal Finish		
29.09.01	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface. 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.		
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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 locklobby 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 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.		
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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.		
30.03.00	UPVC Pipes as per relevant IS code shall be 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).		
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	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.		

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30.08.00	directed by Engineer. If required, lifting facilities for connecting to the manhole of owner's sewer line shall be in bidder's scope.			
	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			
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.			
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31.02.00	(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) NOT USED			
31.03.00	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).			
31.03.00	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.			
	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)			
31.03.00	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.			
31.03.00	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:			
31.03.00	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 finish paint can be eliminated by applying a mist coat of			
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	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 610Gms / Sq. as per IS: 4736.		
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.		
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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 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 / mm ² 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.
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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.		
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		
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	continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38°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:			
	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”.			
34.01.02	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.			
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	(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system. (4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation. (5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply. (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.		
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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.			
	(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.			
34.03.06	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.			
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	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.		
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.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: CS-0011-109(4)-9	PART-B SUB-SECTION-IV-D CIVIL WORKS	PAGE 57 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
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. (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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: CS-0011-109(4)-9	PART-B SUB-SECTION-IV-D CIVIL WORKS	PAGE 58 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS		
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 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.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: CS-0011-109(4)-9	PART-B SUB-SECTION-IV-D CIVIL WORKS
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	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 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.		
39.06.00	NUTS AND BOLTS M.S. Nuts and Bolts shall conform to IS:1363,IS:1364, IS:1367. Hightensile 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.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: CS-0011-109(4)-9	PART-B SUB-SECTION-IV-D CIVIL WORKS	PAGE 61 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS																																				
	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><tr><td>IS : 800</td><td>Code of practice for use of structural steel in general building construction.</td></tr><tr><td>IS : 814</td><td>Specification for covered electrodes for metal arc welding for weld steel.</td></tr><tr><td>IS : 816</td><td>Code of practice for use of metal arc welding for general construction.</td></tr><tr><td>IS : 817</td><td>Code of practice for training and testing of metal arc welders.</td></tr><tr><td>IS : 875 (Pt. I to V)</td><td>Code of practice for design loads other than earthquake) for buildings and structures.</td></tr><tr><td>IS : 1038</td><td>Steel doors, windows and ventilators.</td></tr><tr><td>IS : 1172</td><td>Basic requirements for water supply, drainage and sanitation.</td></tr><tr><td>IS : 1361</td><td>Steel windows for industrial buildings.</td></tr><tr><td>IS : 1786</td><td>Specification for high strength deformed steel bars and wires for concrete reinforcement.</td></tr><tr><td>IS : 1892</td><td>Code of practice for subsurface investigation for foundation.</td></tr><tr><td>IS : 1893</td><td>Criteria for earthquake resistant design of structures.</td></tr><tr><td>IS : 1904</td><td>Code of practice for design and construction of foundations in soils; general requirements.</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 : 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.
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CLAUSE NO.	TECHNICAL 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. (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.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS : 10262Recommended guidelines for concrete mix design. IS : 13311Method of non - destructive testing of concrete. IS : 13755Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a) ASTM 898 -89Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course. AS/NZS 2728Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements. AS : 1365Standards for steel manufacturing. AS : 1397A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated. AS : 3566Self drilling screws for building and construction industry. IRC : 37Guidelines for the design of flexible pavements. -Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated. Indian Explosives Act. 1940 as updated. For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.		
41.00.00	Switchyard Civil Works		
41.01.00	Loads		
41.01.01	Dead Load, Imposed Load, Crane Load, Seismic Load, Equipment Loads etc. shall be as specified elsewhere in the specifications.		
41.01.02	Wind Load: a) Switchyard gantries, towers, equipment supporting structures and lightning mast shall be designed as per IS: 802. The wind load calculations shall be made as per IS: 802 considering the basic wind speed (V_b) as stipulated in “Criteria for wind resistant design of structures and equipment” Appendix-II of Part–I of this specification. b) All other structures covered under the present package shall be designed as per IS: 456 / IS: 800. The wind load calculations to be made as per IS: 875 shall be with the parameters as stipulated in “Criteria for wind resistant design of structures and equipment” Appendix-II of Part–I of this specification.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
41.02.00	Design Parameters for Gantry Towers & Beams, Lightning Mast and Equipment Supporting Structures		
41.02.01	Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to Grade IS:2062 and duly galvanized conforming to IS: 2629 and IS: 4759. All joints shall be bolted connections.		
41.02.02	The analysis of towers and gantries shall be carried out with combined model of critical configurations of towers and gantries using any established structural analysis software like STAAD Pro. etc.		
41.02.03	All bolts for connections shall be of 16mm dia conforming to IS: 12427, property class 5.6 as per IS: 1367 (Part 3). Nuts shall conform to I.S 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS: 5624, and property class shall be 4.6 as per IS: 1367 (Part 3).		
41.02.04	Butt splice shall be used for splicing the main members and splice shall be located away from the node point.		
41.02.05	IS: 802 “Code of practice for use of structural steel in overhead transmission line towers” shall be followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all outgoing and incoming feeders, the conductor span shall be taken as 200m for design purpose.		
41.03.00	Loads and Loading Conditions		
	Switchyard structures shall be designed for the worst combination following loads:		
	1) Dead loads (load of wires/conductors, insulator, electrical equipment and structural members),		
	2) live loads,		
	3) Wind load on bus bars, shield wires, insulator strings, electrical equipment, structural members etc as per IS:802,		
	4) seismic loads,		
	5) loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane),		
	6) loads due to unbalanced tension in conductor/wire,		
	7) Torsional load due to unbalanced vertical and horizontal forces,		
	8) Erection loads,		
	9) Short circuit forces including snap in case of bundled conductors, etc.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Note: (i) The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space. (ii) Short circuit force and wind shall be considered to act simultaneously for the purpose of structure design. (iii) Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately (iv) The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries for both normal and short circuit condition. (v) The distance between terminal and dead end gantry shall be taken as 200 meters.		
41.04.00	Factor of safety: The factor of safety for the design of members for switchyard structures shall be considered as 2.0 for normal condition and 1.5 for short circuit condition.		
41.05.00	Design consideration for Equipment support: The supporting structure for B.P.I., LA, CVT and Isolator equipment's shall be comprised of GI (ERW) pipe of grade YST:210 or of higher grade conforming to IS: 1161 & shall be designed as per IS:806 "Code of Practice for use of steel tubes in general building construction". Minimum diameter of the pipe type support for 765kV structure shall be 300NB, 400kV structure shall be 250NB, for 220kV & 132kV structures shall be 200NB and that for 66kV & 33kV shall be 150 NB. The supporting structure for CT, CSE & Wave Trap equipment shall comprise of lattice structural steel conforming to IS 2062 and shall be designed as per IS: 802. Common raft foundation shall be provided for each pole of isolator.		
41.06.00	Special design consideration for Lightning Mast: Diagonal wind condition shall be considered for Lightning Mast. Diagonal wind shall be taken as 1.2 times the wind calculated on longitudinal/transverse side. Lightning mast shall be provided with minimum two nos. of platforms as per requirement and an external cage ladder for climbing purpose shall be provided up to the platforms. Top of platform shall have grating, railing and two guard plates. The minimum width of platform shall be 900mm.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
41.07.00	Live load of 300kg/m2 above platforms shall be considered for design of Lightning Mast. The fabrication and erection of the switchyard works shall be carried out generally in accordance with IS: 802 and IS: 800. All materials shall be completely shop fabricated and galvanized. Minimum Thickness of Members & Galvanization All steel work used in construction of switchyard structures such as Towers & Beams, Lightning mast and equipment supporting structures including nuts, bolts and washers shall be galvanized. Minimum section thickness shall not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m2 and foundation bolts shall have heavier zinc coating of at least 0.80 kg/m2.			
	41.08.00	Design consideration for Foundation The F.O.S. for foundation shall be 10% more than factor of safety for supporting structure i.e. 2.2 for normal condition and 1.65 for short-circuit condition.		
		41.09.00	PCC LAYER & GRAVEL FILLING IN SWITCHYARD PCC Layer and Gravel filling shall be provided as specified elsewhere in the specifications. Before laying of PCC layer, the subgrade shall be properly compacted and the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity. The anti-weed - soil sterilization details such as manufacturer's name, their specification, test certificate, etc. shall be furnished for Owner's approval. Any modification if required in the proposed anti-weed treatment chemical shall have to be done by the contractor at no extra cost to the Owner. The contractor shall be required to furnish a performance guarantee of three years for the anti-weed treatment. This guarantee shall be commenced from the date of completion of work or date of handing over, whichever is later. Stone/gravel shall be chemically inert, hard, strong durable against weathering, of limited porosity and free from deleterious materials. It shall be properly graded and shall meet the requirements of IS: 383.	
	41.10.00		SWITCHYARD CABLE TRENCHES Cable trenches shall be provided for routing of cables as required and shall be of adequate size. The trenches located within switchyard shall project at least 300 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected to sump pits. The precast RCC covers shall be as per tender drawing (Annexure-IA). Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:250 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided on the edges of RCC cable trenches and any other place where breakage of corners of concrete is expected.	
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NTPC Limited

(A Government of India Enterprise)



LOT-4 PROJECTS

PART - A

(SCOPE OF WORKS)

SECTION – VI

TECHNICAL SPECIFICATION FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(4)-9

LOT-4 PROJECTS

SECTION - VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

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

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SUB-SECTION-II-A2	PROJECT INFORMATION- FARAKKA-I, II & III (3X200 MW + 2X500 MW+ 1X500 MW)
SUB-SECTION-II-A3	PROJECT INFORMATION- KAHALGAON-I&II(4X210MW+ 3X500 MW)
SUB-SECTION-II-A4	PROJECT INFORMATION- SINGRAULI-I&II (5X200MW + 2X500 MW)
SUB-SECTION-II-A5	PROJECT INFORMATION- RIHAND-I(2X500MW)
SUB-SECTION-III	SCOPE OF SUPPLY & SERVICES
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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

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(4)-9

SUB-SECTION-IV	TERMINAL POINTS & EXCLUSIONS
SUB-SECTION-V	SALIENT DESIGN DATA
SUB-SECTION-VI	FUNCTIONAL GUARANTEES& LIQUIDATED DAMAGES
SUB-SECTION-VII	MANDATORY SPARES

PART – B (DETAILED TECHNICAL SPECIFICATION)

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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)

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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	OUTDOOR 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
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PART – B (DETAILED TECHNICAL SPECIFICATION)

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SUB-SECTION-IV-D	CIVIL WORKS

PART – B (DETAILED TECHNICAL SPECIFICATION)

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PART – A

**LOT-4 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(4)-9**

SUB-SECTION-I

INTENT OF SPECIFICATION

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
	SECTION-A			
1.00.00	INTENT OF SPECIFICATION			
1.01.00	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 4 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;			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 1 OF 19

CLAUSE NO.	INTENT OF SPECIFICATION			
1.02.00	l) Reconciliation with customs authorities, as required. 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			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 2 OF 19

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
	necessarily be in line with the specifications. Under no circumstances the specified equipment and services shall be brought out as an alternative offer. In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.			
1.03.00	The following are the equipment's covered in this specification:			
1.03.01	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.			
1.03.02	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.			
1.03.03	Sheds for Slurry re-circulation pumps/Oxidation blowers and Buildings for Limestone Grinding System, Compressors, Gypsum dewatering system & FGD control Room.			
1.03.04	NOT USED			
1.03.05	NOT USED			
1.03.06	All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc.			
1.03.07	Low Height Wet Chimney(s) for the project (except Rourkela Project for which the Wet Chimney under construction is to be used)			
1.03.08	Associated Control & Instrumentation (C&I) equipments.			
1.03.09	Associated Civil, Structural and Architectural works including foundation as specified in Technical Specification.			
1.04.00	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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 3 OF 19

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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 4 OF 19

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(4)-POM-A-001	2
	2)	Scheme of FGD Milling system	0011-109(4)-POM-A-002	1
	3)	Scheme of Gypsum De-watering system	0011-109(4)-POM-A-003	1
4)	P&ID Diagram for ECW System of FGD	0011-109(4)-POM-A-004	1	
5)	Compressed Air System	0011-109(4)-POM-A-005	1	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 5 OF 19

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC																																																	
	(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(4)-POE-J-001/C</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(4)-POE-J-001/C			
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LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 6 OF 19																																																

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC															
	SECTION-B PROVENNESS 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. 1.0 Provenness Criteria/Qualifying Requirements for Equipments/Systems 1.1 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: 1.2 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. Type and Rating for Qualification <table><tr><th>Sl. No.</th><th>Name of Equipment</th><th>Type of Equipment</th><th>Application</th><th>Equipment Rating</th></tr><tr><td rowspan="2">(a)</td><td rowspan="2">Booster Fans</td><td rowspan="2">Axial type with variable pitch control</td><td rowspan="2">Coal fired power plant</td><td>Unit size of 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)</td></tr><tr><td>Unit size of 210 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)</td></tr><tr><td>(b)</td><td>Slurry Recirculation Pumps</td><td>Centrifugal type</td><td>Wet Limestone based FGD application in Coal fired</td><td>Unit size of 500 MW & Above - Flow 10200 m3/hr (min.) with Head 16</td></tr></table>	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	Unit size of 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)	Unit size of 210 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)	(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired	Unit size of 500 MW & Above - Flow 10200 m3/hr (min.) with Head 16
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 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)													
				Unit size of 210 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)													
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired	Unit size of 500 MW & Above - Flow 10200 m3/hr (min.) with Head 16													
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CLAUSE NO.	INTENT OF SPECIFICATION 				
	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
				power plant	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 210 MW & Below – Flow 5680 m3/hr (min.) with Head 16 Meters of Liquid Column (min.)
					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 210 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 application in Coal fired power plant or any other process application .	Station size of 2001 MW – 2600 MW Capacity 40 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh Station size of 1501 MW – 2000 MW - Capacity 30 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh
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CLAUSE NO.	INTENT OF SPECIFICATION					
	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	
					Station Size of 1000 MW -1500 MW Capacity 20 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 210 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 2001 MW- 2600 MW-Capacity 65 T/hr (min.)	
					Station size of 1501 MW-2000 MW-Capacity 50 T/hr (min.)	
					Station Size of 1000 MW – 1500 MW-Capacity 35 T/hr (min.)	
	The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 1.2 (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.					
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CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC						
1.3	The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 1.2 (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 (Booster fan/ID fan.) 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 1.2 (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 1.2 (a) above for the Booster Fans. For value of * and ** refer table below. <table><tr><td>*</td><td>**</td></tr><tr><td>195 MW</td><td>195 MW – 500 MW</td></tr><tr><td>500 MW</td><td>660 MW</td></tr></table>				*	**	195 MW	195 MW – 500 MW	500 MW	660 MW
*	**									
195 MW	195 MW – 500 MW									
500 MW	660 MW									
1.4	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 1.2 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 1.2 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.									
1.5	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 1.2 (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 manufactur-ing 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 1.2 (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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 10 OF 19						

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1.6	(i) In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 1.2 (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 1.2 (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 (ii) In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 1.2 (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 1.2 (d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills.			
1.7	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 1.2 (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 1.2 (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.			
1.8	In case the Bidder or the proposed subvendor is a manufacturer of Pumps, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps and slurry pumps, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated above at clause 1.2 (b) & 1.2 (e) of Section B Intent of Specification for the Slurry Recirculation Pumps and slurry pump respectively. 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.			
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CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
1.9 1.10 1.11 2.0 2.1 2.2 2.3 2.4	Before taking up the manufacturing of such equipment(s) as per clause 1.3, 1.4, 1.5, 1.6(i), 1.7 & 1.8 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. 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 1.2 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite. Sub QR for Civil Works: 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. Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.1. 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). For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height. In case Bidder or its agency do not meet the requirements at 2.1 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			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 12 OF 19	

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC					
2.5	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 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: 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.						
	2.6	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.5. 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 – 500 MW</td></tr><tr><td>500 MW</td><td>660 MW</td></tr></table>	*	**	195 MW	195 MW – 500 MW	500 MW
*	**						
195 MW	195 MW – 500 MW						
500 MW	660 MW						
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 13 OF 19			

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
3.0	PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS			
3.1	HT MOTORS			
3.1.1	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.			
3.2	LT SWITCHGEAR			
3.2.1	ROUTE 1			
3.2.1(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			
3.2.1(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.			
3.2.2	ROUTE 2			
3.2.2(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			
3.2.2 (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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 14 OF 19

CLAUSE NO.	INTENT OF SPECIFICATION			
3.2.2(iii)	And 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.			
3.2.2(iv)	And 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. 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.			
3.3	33 kV / 11 kV / 6.6 kV / 3.3 kV SWITCHGEARS			
3.3.1	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.			
3.3.2	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.			
3.4	NUMERICAL RELAYS			
3.4.1	Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 15 OF 19

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3.5	used for application in Feeder Protections/Transformer Protections/Motor protections. These relays should have been in successful operation for at least two (2) years.			
	TRANSFORMERS			
	3.5.1	FGD Tie Transformer (50 MVA 220KV CLASS TRANSFORMER)		
	(a)	Bidder/Sub-Vendor should have designed, manufactured and supplied at least two (2) nos. (one each at two different installations) of 220 kV or above class transformers of atleast 50 MVA capacity which should be in successful operation for atleast two (2) years.		
		And		
	(b)	90 MVA, 132 KV or higher rated oil filled transformer manufactured by Bidder/Sub-Vendor should have been successfully short circuit tested.		
	3.5.2	FGD TIE TRANSFORMERS (132 KV CLASS TRANSFORMERS)		
	(a.)	Bidder/Sub-vendor should have designed, manufactured and supplied at least two (2) numbers (one each at two different installations) of 132 kV or above class transformers of at least 110MVA capacity which should have been in successful operation for at least two years.		
		And		
	(b.)	Bidder/Sub-Vendor should have its own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).		
	And			
(c.)	90 MVA, 132 KV or higher rated oil filled transformer manufactured by Bidder/Sub-Vendor should have been successfully short circuit tested.			
3.5.3	AUXILIARY OIL FILLED TRANSFORMERS			
	(Transformers not covered under Clause 3.5.1 & 3.5.2)			
(a)	The 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.			
	And			
(b)	Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).			
	And			
(C)	16 MVA, 11KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested.			
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	Note (applicable for Cl. No. 3.5.1, 3.5.2, 3.5.3): (i) Two different installations means 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.			
3.6	Switchyard 132KV/220kV Equipment I. 132KV/220kV CIRCUIT BREAKERS 132KV/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 132KV/220KV or above class which should have been in successful operation for at least two(2) years. II. 132KV/220 kV INSTRUMENT TRANSFORMERS (Current Transformers / Voltage Transformers as Applicable 132KV/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 132KV/220 kV or above class which should have been in successful operation for atleast two (2) years III. 132KV/220 kV DISCONNECTORS 132KV/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 132KV/220kV or above class which should have been in successful operation for atleast two (2) years. IV. 132KV/220 kV SURGE ARRESTORS 132KV/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			
3.7	CONTROL AND PROTECTION 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.			
4.0	PROVENNESS CRITERIA FOR CONTROL AND INSTRUMENTATION (C&I) EQUIPMENTS / SYSTEMS			
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	The Bidder or its proposed sub vendor(s) should meet the provenness requirements as stipulated under clause 4.1, 4.2 and 4.3. 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-4 FGD package unless otherwise specified in the respective clauses. 4.1 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. 4.2 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. 4.3 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. Notes:- (A) Control system for BOP application referred in Para 4.1 and 4.2 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 auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units. 5.0 DELETED 6.0 DELETED			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 18 OF 19	

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
7.0 8.0 9.0 10.0 11.0	DELETED 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. Balance equipments/ systems The Bidder at his option can source the balance of plant equipment/systems not covered in clause 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0 & 8.0 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. 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. 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.			
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SUB-SECTION-II

PROJECT INFORMATION

(CHAPTERS FOR EACH 8 PROJECTS ENCLOSED SEPARATELY)

**LOT-4 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(4)-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 <table><tr><td>III A</td><td>-</td><td>Mechanical equipment and associated systems</td></tr><tr><td>III B</td><td>-</td><td>Electrical systems</td></tr><tr><td>III C</td><td>-</td><td>C&I systems</td></tr><tr><td>III D</td><td>-</td><td>Civil works</td></tr></table>				III A	-	Mechanical equipment and associated systems	III B	-	Electrical systems	III C	-	C&I systems	III D	-	Civil works
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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(4)-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.			
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 at site. All such temporary equipments/components shall be brought to site at least			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(4)-9	PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES	PAGE 2 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC	
	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.		
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		
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1.08.01	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.			
	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			
	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.			
1.08.02	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.			
1.08.03				

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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.			
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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.			
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SUB-SECTION-III-A

MECHANICAL EQUIPMENTS & SYSTEMS

SUB-SECTION-III-A1

FLUE GAS DESULPHURISATION SYSTEM

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	be mixed with treated flue gas at the outlet of the absorber. However, Bypass ducting shall be designed for 40% of the total flue gas flow of the inlet of the FGD system. 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.			
2.02.00	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 Sprayer or any other proven system as per the practice of the FGD vendor.			
2.03.00	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.			
2.04.00	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.			
2.05.00	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.			
2.06.00	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. Feeding of lime to bucket elevator can be manual. 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 (maximum capacity) 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 4 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.			
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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).			
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. On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve.			
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.			
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4.00.00 4.01.00 4.01.01 4.01.02 4.01.03 4.01.04 4.01.05 4.01.06 4.01.07 4.01.08 4.01.09 4.01.10	ABSORBER SYSTEM An independent Limestone Forced Oxidation (LSFO) type absorber system shall be provided for each 500 MW unit. Common absorber for 200 and 210 MW units (upto a maximum three (3) number of units i.e if number of units are three (3) then one (1) absorber catering to the requirement of three (3) units. if number of units are six (6) then two (2) absorbers, each absorber catering to the requirement of three (3) units. If number of units are five (5) then two (2) absorbers, one (1) absorber catering to the requirement of the two (2) units and another absorber catering to the requirement of three (3) units). For detail refer the Table : 1 & Table 2. Each absorber system shall be complete with : 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. 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.) Complete Ducting System from ID fan common outlet duct to absorber tower & from absorber outlet to wet stack chimney. 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. 1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition. All connecting piping and valves required by the system. 2x100% gypsum bleed pumps. Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves. On/Off type Diaphragm valves in Gypsum circulation lines to be provided instead of pinch control valve. Routing of the duct/piping system complete with supports, structures, trestles, absorber platforms, as required shall be in the contractor's scope of supply. Passenger cum Goods elevator of minimum capacity of 1000 kgs for each Absorber of height of more than 20 m. (to be provided in case height of absorber is higher than 20m).			
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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			
	ii. One vacuum belt filter			
	iii. One no. vacuum receiver			
	iv. One no. vacuum pump			
	v. One set of secondary hydro-cyclones			
5.03.00	vi. Complete piping and valves for the system along with wash water line.			
	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,			
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	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 other structures required for the system shall be included in the scope of the contractor.			
7.00.00	PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME			
7.01.00	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.			
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.			
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. 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.			
7.03.00	Two (2) clarified water Storage tanks (each tank catering to the clarified water requirement for one vaccum Belt Filter) along with two numbers of 2x100 % clarified Booster water pumps, if required, from terminal point.			
7.04.00	2x100% cake washing Pumps for each Vacuum Belt Filter.			
7.05.00	2x100% cloth washing Pumps for each Vacuum Belt Filter.			
7.06.00	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.			
7.07.00	All drains & overflow lines from the tanks shall be terminated to the nearest trench/drain.			
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7.08.00	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.			
7.09.00	Hardness of rubber lining wherever applicable (tank, pipes etc) shall be 55±5 durometer (Shore A).			
8.00.00	SUMP & SUMP PUMPS			
8.01.00	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.			
8.02.00	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 back the water in the sump into the respective system. The Interior surface of the Sumps shall be lined with FRP lining / PP lining of Minimum 5 mm thickness or Acid Resistant Tiles.			
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			
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11.00.00 11.01.00 12.00.00 13.00.00 14.00.00 15.00.00 16.00.00 17.00.00 18.00.00 19.00.00 20.00.00 21.00.00 22.00.00 22.01.00	temperature more than 60 degree Celsius. The insulation thickness shall be designed based on criteria specified in Part-B, Section-VI. Buildings 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. Contractor shall provide Corrosion protection painting for structures & equipments as described in the specification 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. 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. 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. Contractor shall provide compressed air system for the FGD system as detailed in Sub-Section III-A2. Contractor shall provide FIRE FIGHTING SYSTEM as detailed in Sub-Section III-A3. Contractor shall provide EQUIPMENT COOLING WATER SYSTEM as detailed in Sub-Section III-A4. Contractor shall provide Limestone & Gypsum handling & storage system for FGD as detailed in Sub-Section III-A5. The scope of civil works shall be as per Sub-Section-III D. 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. Booster Fan & Isolation Gates For each absorber, 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.			
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22.02.00	(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. Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan. 2x100 % seal air fans common for both the guillotine type gates at suction side and 2x100 % seal air fans common for both the guillotine type gates at discharge side of booster fans are also acceptable. In case of Kahalgaon-I & II (4 X 210 MW) One quick acting biplane bypass damper shall be provided at the bypass line of the absorber (Absorber bypass line shall be designed for 40% flue gas flow entering at the inlet of FGD system) for controlling the flue gas flow. The Gates / damper 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.			
	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.			
	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			
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24.00.06	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. 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.			
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Table :1

Total 29 units of 5.950 GW (Unit rating 200 MW / 210MW)								
S.No	Project	Capacity (MW)	Concept	Flue Gas Treatment	Untreated Flue Gas	Booster FAN	Absorber no & capacity	No of Flue (For chimney refer note below)
1.	FGUTPP St-I, II & III (2 X 210 + 2 X 210 + 1 X 210)	1050	Stage-I two units flue gas combined	100 %	0 %	2 Booster fan for stage I	1 (420 MW)	2 x 210 MW – One Flue
			Stage-II & III three units flue gas combined	100 %	0 %	2 Booster fan for stage II & III	1 (630 MW)	3 x 210 MW – One Flue
2.	Farakka St-I (3 X 200)	600	Stage-I three units Flue gas combined	100 %	0 %	2 Booster fan for stage I	1 (600 MW)	3 x 200 MW – One Flue
3.	Kahalgaon St- I (2 X 210)	420	Stage-I two units Flue gas combined	80 %	20 %	2 Booster fan for stage I	1 (336 MW)	2 x 210 MW – One Flue
4.	Kahalgaon St- I (2 X 210)	420	Stage-I two units Flue gas combined	80 %	20 %	2 Booster fan for stage I	1 (336 MW)	2 x 210 MW – One Flue
5.	Singrauli St- I (5 X 200)	1000	Stage-I two units Flue gas combined	100%	0 %	2 Booster fan for stage I	1 (400 MW)	2 x 200 MW – One Flue
			Stage-I three units flue gas combined	100%	0 %	2 Booster fan for stage I	1 (600 MW)	3 x 200 MW – One Flue

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	Table :2						
	Total 19 units of 9.5 GW (Unit rating 500 MW)						
	S.No	Project	Capacity (MW)	Flue Gas Treatment	Booster FAN	Absorber	No of Flue (For Chimney refer note below)
	1.	Farakka St-II & III (2 X 500 + 1 X 500)	1500	100%	6 (Two booster fan for one unit)	3 (500 WM each)	1 x 500 MW – One Flue
	2.	Kahalgao n St- II (3 X 500)	1500	100%	6 (Two booster fan for one unit)	3 (500 WM each)	1 x 500 MW – One Flue
	3.	Singrauli St- II (2 X 500)	1000	100%	4 (Two booster fan for one unit)	2 (500 WM each)	1 x 500 MW – One Flue
	4.	Rihand St-I (2 X 500)	1000	100%	4 (Two booster fan for one unit)	2 (500 WM each)	1 x 500 MW – One Flue
	Note : Bidder may opt for individual (One flue in one chimney) or combination (twin flue in one chimney) for each LOT-4 projects, based on the layout feasibility and their proven practice considering the chimney height indicated in the Salient design data of Sub-Section V.						
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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.		
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
3.00.00	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			
4.00.00	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 15Nm ³ /min at discharge pressure of 8.5 Kgf/cm ² (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 m ³ (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.			
	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.				
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.				
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	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.		
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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 fire water 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 fire water 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 fire water 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): 8 Nos. 2. CO₂ type (4.5 kg Cap IS:15683): 8 Nos. 3. Dry chemical type (6 kg Cap IS:15683) : 8 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				
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	commissioned. Any amendments, modified rules to the latest TAC 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 4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO: CS-..0011-109(4)-9	SUB SECTION-III A-3 PLANT UTILITY	Page 2 of 2

SUB-SECTION-III-A4

EQUIPMENT COOLING WATER SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
1.00.00 1.01.00 1.01.01	EQUIPMENT COOLING WATER SYSTEM FOR FGUTPP ST-I (2X210MW), -II (2X210MW) AND -III (1 X210 MW) SCOPE Equipment Cooling Water (ECW) System The Bidder shall provide common Equipment Cooling water system (Primary & Secondary) for stage- II & III units whereas separate Equipment Cooling water system (Primary & Secondary) for stage- I 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. ECW for FGUTPP ST-I (2X210MW) FGD SYSTEM (a) Cold secondary water shall be tapped from existing clarified water tank of FGUTPP ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with its valves etc. from FGD clarified water tank to PHEs and make up water line for AC & Ventilation System via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank and discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 3 x50% (2 working + 1 standby) capacity of plate type heat exchangers. (g) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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.			
	LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 1 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
1.01.02	(m) Any other equipment not covered above but required to complete the system. ECW for FGUTPP ST-II (2X210MW) & ST- III (1 X210 MW) FGD SYSTEM (a) Cold secondary water shall be tapped from the existing CW blow down header of stage- II & III available nearest to the FGD area to be pumped to PHEs through FGD Auxiliary (Secondary) Cooling water pumps. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) One header shall be tapped from existing HVAC header to FGD area for Gypsum washing and make up water line for AC & Ventilation System. (d) 2x100% capacity self-cleaning strainers on the secondary side. (e) 4 x 33.3% (3 working + 1 standby) capacity of plate type heat exchangers. (f) 5 x 33.3% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives for pumping of water from Cold secondary water header to discharging into the FGD system as process water. (g) 4 x 33.3% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One Overhead DM water tank (ECW O/H tank). (i) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (j) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (k) All Misc. 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. (l) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 2 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
2.00.00 2.01.00 2.01.01	EQUIPMENT COOLING WATER SYSTEM FOR KAHALGAON STPP ST-I (4X210MW) -II (3 X500 MW) SCOPE Equipment Cooling Water System The Bidder shall provide separate Equipment Cooling water system (Primary & Secondary) for stage- I & II 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. ECW for KAHALGAON STPP ST-I (4X210MW) FGD SYSTEM (a) Cold water shall be pumped from CW OAC of stage-I to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines from FGD clarified water tank to PHEs and make up water line for AC & Ventilation System via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (d) 6 x 25 % (4 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. With necessary pipe line and valves etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 6x100 % (4 Working + 2 standby) auto priming system for Auxiliary (Secondary) Cooling water pumps system. (f) 2x100% capacity self-cleaning strainers on the secondary side. (g) 5 x 25% (4 working + 1 standby) capacity of plate type heat exchangers. (h) 5 x 25% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (i) One FGD clarified water tank. (j) One Overhead DM water tank (ECW O/H tank). (k) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (l) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump (m) All Misc. 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. (n) Any other equipment not covered above but required to complete the system.			
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2.01.02	ECW for KAHALGAON STPP ST-II (3X500 MW) FGD SYSTEM (a) Cold secondary water shall be tapped from the existing CW blow down header of stage- II available nearest to the FGD area and to be pumped to PHEs through FGD Auxiliary (Secondary) Cooling water pumps. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) One header tapped from existing HVAC header to FGD area for Gypsum washing and make up water line for AC & Ventilation System. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 4 x 33.3% (3 working + 1 standby) capacity of plate type heat exchangers. (e) 5 x 33.3% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (f) 4 x 33.3% (3 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 and piping for emergency makeup to ECW tank from condensate transfer pump (j) All Misc. 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. (k) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 4 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	EQUIPMENT COOLING WATER SYSTEM FOR FARAKKA STPP ST-I (3X200MW),-II(2X500MW) AND -III(1X500)			
3.00.00	SCOPE			
3.01.00	Equipment Cooling Water System The Bidder shall provide separate Equipment Cooling water system (Primary & Secondary) for stages I ,II and III 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.			
3.01.01	ECW for FARAKKA STPP ST-I (3X200MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of FARAKKA STPP ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with valves etc. from FGD clarified water tank to PHEs and make up water line for AC & Ventilation System. Via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 5 x 33.3 % (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 4 x 33.3 % (3 working + 1 standby) capacity of plate type heat exchangers. (g) 4 x 33.3 % (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 5 OF 10

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3.01.02	ECW for FARAKKA STPP ST-II (2X500MW) FGD SYSTEM (a) Cold water shall be tapped from existing service water tank of FARAKKA STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with valves etc .from FGD clarified water tank to PHEs and make up water line for AC & Ventilation System. Via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 3 x 50 % (2 working + 1 standby) capacity of plate type heat exchangers. (g) 3 x 50 % (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 6 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
3.01.03	ECW for FARAKKA STPP ST-III (1X500MW) FGD SYSTEM (a) Cold secondary water shall be tapped from the existing CW blow down header of stage- III available nearest to the FGD area and to be pumped to PHEs through FGD Auxiliary (Secondary) Cooling water pumps. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (c) One header tapped from existing HVAC header to FGD area for Gypsum washing and Make up water line for Ac & Ventilation system. (d) 2x100% capacity self-cleaning strainers on the secondary side. (e) 2 x 100 % (1 working + 1 standby) capacity of plate type heat exchangers. (f) 3 x 100% (1 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives for pumping of water from Cold secondary water header to discharging into the FGD system as process water. (g) 2 x 100 % (1 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One Overhead DM water tank (ECW O/H tank). (i) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (j) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (k) All Misc. 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. (l) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 7 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	EQUIPMENT COOLING WATER SYSTEM FOR SINGRAULI STPP ST-I (5X200MW) -II (2 X500 MW)			
4.00.00	SCOPE			
4.01.00	Equipment Cooling Water System The Bidder shall provide separate Equipment Cooling water system for stage- I & II 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.			
4.01.01	ECW for SINGRAULI STPP ST-I (5X200MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of Singrauli ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with valves etc .from FGD clarified water tank to PHEs and Make up water line for AC & Ventilation system via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 7 x 20% (5 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 6 x 20% (5 working + 1 standby) capacity of plate type heat exchangers. (g) 6 x 20% (5 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 8 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
4.01.01	ECW for SINGRAULI STPP ST-II (2X500MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of SINGRAULI STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with valves etc .from FGD clarified water tank to PHEs and Make up water line for AC & Ventilation system via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 3 x 50 % (2 working + 1 standby) capacity of plate type heat exchangers. (g) 3 x 50 % (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 9 OF 10

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
5.00.00 5.01.00	EQUIPMENT COOLING WATER SYSTEM FOR RIHAND STPP-I (2 X500 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units of stage-I 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) Cold water shall be tapped from existing clarified water tank of RIHAND STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. (b) Cold water Pipe lines along with valves etc .from FGD clarified water tank to PHEs and Make up water line for Ac & Ventilation system via FGD Auxiliary (Secondary) Cooling water pumps. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives with necessary valves and accessories etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 2x100% capacity self-cleaning strainers on the secondary side. (f) 3 x 50 % (2 working + 1 standby) capacity of plate type heat exchangers. (g) 3 x 50 % (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. (h) One FGD clarified water tank. (i) One Overhead DM water tank (ECW O/H tank). (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 10 OF 10

SUB-SECTION-III-A5

LIMESTONE & GYPSUM HANDLING SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	Intent of specification and Scope of work and Supply: This specification is intended to cover the following activities and services in respect of all the equipment of Limestone Handling Plant & Gypsum Handling Plant to be installed for FGD Package, 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”, Part-A, Section–VI of Technical Specification. (i) Detailed design and engineering of all the equipments and equipment system(s). (ii) Complete manufacture including shop testing/ type testing. (iii) Providing engineering data, drawings, Commissioning procedures and O & M manuals, etc. for the employer’s review, approval and records. (iv) Packing and transportation from the manufacturer’s works to site including transit insurance, customs clearance/ port clearance, if required. (v) Receipt, unloading, storage, preservation, conservation and insurance of equipment at site. (vi) Fabrication, pre-assembly, (if any), erection, testing and putting into satisfactory operation of all the equipment including successful completion of facilities. (vii) Associated civil, structural, architectural and electrical and control and instrumentation works. (viii) Commissioning and completion of facilities and Performance Guarantee Tests after successful completion of initial operation. (ix) Furnishing of spares on FOR site basis and handing over to NTPC stores. (x) Reconciliation with custom authorities, if applicable. (xi) Satisfactory completion of the contract.			
1.01.00	Before submitting his bid, 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.			
1.02.01	Bidder is expected to visit the site for confirming the layout feasibility and fixing the material handling facilities. Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid.. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid. In			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT	PAGE 1 OF 12

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	the absence of this, the bid shall be deemed incomplete and may be liable for rejection.			
1.02.02	NTPC reserves the right to freeze a basic layout for proposed facilities under this package after post techno commercial bid discussions.			
1.03.00	The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of specification along with scope of work and further ensuring operability and the reliability of the complete system covered under this specification.			
1.04.00	Cleaning of any debris produced by the bidder during erection and commissioning shall be done immediately at each front by the bidder.			
1.05.00	Bidder to extend all help and documentary support for compliance and addressing any statutory issues raised at site which pertains to the area/ work under bidder's scope.			
2.00.00	DETAILED SCOPE OF WORK			
2.01.00	Limestone Handling Plant (LHP)			
2.01.01	Limestone will be received to power plant through road by trucks. Lime stone received through Road shall be unloaded by Two (2) numbers Truck Tipplers for each unit or each group of units for which common FGD facilities has been proposed. Truck tipplers units each of minimum 40T capacity (Gross vehicle weight considered to be 60 T minimum) to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers. Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ Surface feeder for each set (02 numbers) of truck tipplers, for unloading of limestone from trucks/ self-tipping trucks/ loader shovels, complete with drives, accessories. All mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house.			
2.01.02	Limestone shall be conveyed to usage point through double stream of capacity 100% each for conveying & crushing.			
2.01.03	Lime stone Belt Conveyors along with bucket elevator complete with associated tunnel, conveyor galleries along with its supporting structures, short supports, stringers, deck plate, seal plate, conveyor foundations, drive motors, drive units, pulleys, idlers, gravity take ups including guides, pits etc., internal and external belt cleaners, pull chord switches, belt sway, zero speed switches, electro-hydraulic thruster brakes, all electrical etc. including all civil, structural and architectural works for tunnel, conveyor gallery, gallery supporting trestles and their associated foundations, as applicable.			
2.01.04	Suitable number of Lime stone crusher house (CH) for complete FGD system of a plant with all civil, structural, architectural and electrical works etc. accommodating 01 nos. crushers(1x100% or 2x50%) per incoming stream of lime stone conveyor and associated vibrating screening feeders, R&P and Rod gates etc., passenger			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
2.01.05 2.01.06 2.01.07 2.01.08 2.01.09 2.01.10 2.01.11 2.01.12	cum goods elevator, conveyors, chute work along with actuator operated flap gates, monorails & hoists, hoist maintenance platform, external and internal staircases, hand rails and other equipment such as sampling unit, dust extraction system etc. as specified elsewhere. One(1) numbers of vibrating screening feeders per crusher in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc. Suitable numbers of hammer crusher complete with drives, accessories all mechanical, electrical civil & structural works, including crusher-supporting foundations, vibration isolation system with springs and viscous dampers, vibration-monitoring system etc. Crushed limestone Reclaim Hopper (RH) /Silo, machinery hatches at each of end of limestone storage shed for RH, fully / partially underground or over ground junction towers, tunnels and pent houses, complete with civil, structural, architectural, electrical and C&I works including over ground structural shed for entire length of limestone ground storage and machinery hatches, removable chequered plate covers over openings in machinery hatches for handling underground equipment like paddle feeders etc. (as applicable). For Limestone storage shed and for all buildings, other equipment such as Dry type Dust Extraction system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification. Junction towers (along with underground / over ground RCC structures), tunnel/conveyor gallery / bucket elevator complete with all civil, structural, architectural, electrical and C&I works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. All over-ground junction towers shall have separate debris disposal chute up to the ground floor. Underground junction towers shall be provided with machinery hatches along with monorail, electric hoist for handling equipment from underground to over ground. Complete chute work along with chute block switches and actuator operated flap gates, mobile discharge pulleys (as applicable) in all junction towers between various conveyors. Crushed limestone will be fed through belt feeder and bucket elevator for further storage in to lime stone store yard and lime stone storage Silos. Complete belt feeder and bucket elevator assembly along with related mechanical, electrical and civil work is in the scope of bidder. Suitable number of motorized travelling tripper / flow diverter plough (as applicable) on each feeding conveyor for feeding the crushed limestone to the storage silo. Trippers/plough feeder shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc. Requirement of flow diagram is minimum. Suitable numbers of covered storage silo /shed with limitation of minimum two numbers and capacity is sufficient to stock the 7 days requirement of limestone to be			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT	PAGE 3 OF 12	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
2.01.13 2.01.14 2.01.15 2.01.16 2.01.17 2.01.18 2.01.19 2.01.20 2.01.21	provided for storage of crushed limestone of each unit or group of units for which common FGD facilities has been proposed. The capacity of limestone storage silos shall be sufficient to cater the seven day consumption requirement of each unit or group of units for which common FGD facilities has been proposed, however capacity of each silo should not be more than 2000 MT. Suitable number of vibratory feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors and Bucket elevators to feed into day's silo. Two (2) numbers paddle feeders (in case of covered storage shed) complete with all electrical, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling on floor of reclaim hoppers along with accessories, shall be installed at the bottom of the reclaim hoppers to scoop the limestone from reclaim hoppers and feed limestone on to the underground conveyors. One (1) nos. of lime sampling units, one for as received limestone in crusher house complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms, hoists etc. Suitable number of ploughs and its actuating mechanism shall be mounted on each conveyor with bucket elevator to feed limestone into limestone days silo /mill bunkers. Minimum four (4) Nos. sump pumps in limestone storage shed / Silos and (2) numbers in each complete or partial underground TPs, complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to bottom ash slurry sump /disposal point as specified during detail engineering including pipes etc. Along with main silo area separate sump pump also require in truck unloading zone, which is under the bidder scope. 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) complete with all mechanical, electrical, civil and structural works and associated foundations. Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works. Exhaust fans to be provided in all battery rooms and all toilets complete with electrical, civil & structural works etc. Supply and exhaust fans along with required ducting shall also be provided for all underground Structures/junction towers complete with all mechanical, electrical, civil and structural works and associated foundations. One (1) number of conventional enclosure type passenger cum goods elevator having capacity of 16 persons (1088 kg) complying to IS:14665 (latest edition) with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house. Staircase access for machine room shall also be provided by the bidder Suitable numbers of in line magnetic separators (one no. on each conveyor feeding to crusher house) and suitable numbers of suspended magnets, (one no. on each conveyor feeding to Limestone bunker/silo) ,complete with reject chutes, reject			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT	PAGE 4 OF 12	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
2.01.22 2.01.23 2.01.24 2.01.25 2.01.26 2.01.27 2.01.28 2.01.29 2.01.30 2.01.31 2.01.32	trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories. Suitable numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to lime stone day silo) complete with all mechanical, electrical, civil, structural works and accessories. Suitable numbers of electronic type belt scales (min. one no. on each conveyor) feeding to crusher house and conveyor feeding to lime stone lime stone day silo) for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories. Complete dust extraction system for control of fugitive dust in limestone storage shed / Silos, junction towers, crusher house complete with fans, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works. 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. Cooling water system (as applicable) for scoop couplings, for complete limestone handling plant. Air cooled type scoop couplings are also acceptable. 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. One (1) number of belt vulcanizing machine, suitable for all belt widths in limestone handling system, complete with all mechanical, electrical, accessories and consumables for one year of consumption. Further belt jointing facilities as specified shall be provided. Minimum one (1) no. pit less type Weighing Bridge of capacity 100 MT for Road trucks / Tipplers shall be provided each in Limestone unloading area and in Gypsum Loading area. 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. Drainage of LHP buildings, tunnels, conveyor galleries and limestone storage shed / Silos including all civil & structural works as detailed out elsewhere in the specification. All equipment/fittings, supporting structure, along with insert plates, bolts, accessories, MS sleeves, base plates, grouting as may be required and proper alignment etc.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
2.01.33	Complete un-used set of all special tools and tackles, which are necessary or convenient for erection, commissioning and overhauling of any equipment, covered under the scope.			
2.01.34	First fill of all consumables, e.g.; oils and lubricants for first fill and one year toppings requirements shall be in the bidder scope.			
2.01.35	Preservative shop coating, final painting of all structures and equipment.			
2.01.36	All inserts, anchor bolts, foundation bolts for contractor's equipment, platforms etc. in the entire LHP.			
2.01.37	All necessary grouting & finishing of the floor after welding at all such pockets & elsewhere is in Contractor's scope.			
2.01.38	Complete AC, Ventilation and firefighting system for complete Lime stone handling system is to be provided by bidder.			
2.01.39	Bidder to note that the above list is inclusive but not exhaustive and any work required for integration of complete system and ensuring its satisfactory running shall be included in the scope of work and same to be provided for this package			
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 as applicable.			
3.02.00	One number of covered storage shed for gypsum. The minimum size of storage shed is indicated in the flow diagram to store gypsum equivalent to gypsum generation of minimum 7 days at Design point (Generation of all units to be considered). Alternatively, Gypsum can be stored in silos like Euro silo or 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			
3.03.00	Minimum two (2) nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves upto bottom ash slurry sump /disposal point as specified during detail engineering.			
3.04.00	Complete plain water sprinkler type dust suppression system for control of fugitive dust in gypsum storage shed, complete with pumps, water tanks, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works.			
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.			
3.06.00	Suitable number of motorized travelling tripper / Flow diverter (as applicable) on each feeding conveyor for feeding the gypsum to the covered storage shed. Trippers			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT	PAGE 6 OF 12

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
	shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.		
3.07.00	Bidder to provide feeding arrangement from head end of the gypsum conveyor discharge to the truck with telescopic chute arrangement in gypsum storage shed. There will be truck bay inside the storage shed. Entry of truck shall be on one side and exit at the other side. Capacity of the storage shed shall be for 7 days requirement of the gypsum generation at design point (Generation of all units). Further, other requisite facilities in Gypsum storage shed for loading the Gypsum from storage shed to user's trucks using front-end loader/ pay loader in case Gypsum not directly fed into truck. Front-end loader/ pay loader is not in bidder's scope.		
3.07.08	Bidder to note that the above list is inclusive but not exhaustive and any work required for integration of complete system and ensuring its satisfactory running shall be included in the scope of work and same to be provided for this package.		
3.07.09	Complete AC, Ventilation and firefighting system for complete gypsum handling System is in bidder scope of work.		
4.00.00	LIMESTONE AND GYPSUM HANDLING PLANTS EQUIPMENT'S: (Brief Guidelines)		
4.01.00	a. Rated capacity of all other Limestone Handling Conveyors shall be 150 MTPH (min). b. Rated capacity of Limestone handling system for truck unloading and reclaim conveyors from storage shed/silo to limestone mill bunkers shall be 150 MTPH (min). c. The rated capacity of all Gypsum handling conveyors shall be 150MTPH Belt speed for 150 MTPH conveyors shall not be more than 2.0 m/s		
4.02.00	All conveyors shall be designed for 110% of rated capacity. Rated capacity (corresponding to LHP&GHP capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed Capacity. For purpose of guaranteed power consumption rated capacity shall be considered in either case.		
4.03.00	2x100 %(one working + one standby) conveying stream shall be provided in the LHP&GHP .		
4.04.00	Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient		
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4.05.00	Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent International Standard. Ai value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.															
4.06.00	All mechanical, Electrical, civil and structural system design shall consider: a) Simultaneous running of both conveyors at rated capacity. b) Starting of one stream with other stream in standstill condition. c) Starting of one stream with other stream in operation at rated capacity. d) Round the clock operation of Limestone Handling Plant. e) The following aspects shall be taken care of limestone : i) The limestone delivered to power station shall be of size 250mm and below. However, occasionally 1-2% limestone of 400 mm lump size may also be encountered. ii) Due to open cast method of mining involved, the limestone may contain shale and sand stone as high as 20%. Also occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with limestone . iv) The limestone as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above. f) For volumetric computations of limestone handling system the bulk density of limestone shall be taken as 1400 kg/m3. However for torque & drive requirements the density of lime stone shall be taken as 1700 kg/m3. For density calculation of Limestone slurry ,density of limestone shall be taken as 2700 Kg/m3. For gypsum, the bulk density shall be taken as 900 kg/m3 for volumetric computation and 1250 kg/m3 for torque and drive requirements. For density calculation of Gypsum slurry ,density of Gypsumshall be taken as 2500 Kg/m3															
4.07.00	LHP EQUIPMENT a) Design capacities & margins <table><tr><th>Sl no</th><th>Equipment</th><th>Duty requirement</th><th>Design capacity as %age of duty requirement</th></tr><tr><td>1</td><td>Crushers</td><td>2x50% or 1x 100%</td><td>110%</td></tr><tr><td>2.</td><td>Vibrating feeders</td><td>2x50% or 1x 100%</td><td>110%</td></tr></table>				Sl no	Equipment	Duty requirement	Design capacity as %age of duty requirement	1	Crushers	2x50% or 1x 100%	110%	2.	Vibrating feeders	2x50% or 1x 100%	110%
Sl no	Equipment	Duty requirement	Design capacity as %age of duty requirement													
1	Crushers	2x50% or 1x 100%	110%													
2.	Vibrating feeders	2x50% or 1x 100%	110%													
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4.08.00	3.	Paddle feeders	1x 100%	150%
	4	Belt feeder for crusher house	2x50% or 1x 100%	110%
	Drive equipment Rating Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors a) For conveyors of belt conveyor systems *110% of actual power at drive motor output shaft at specified design capacity b) Crushers, monorail hoists (travel and hoisting), elevators, rack and pinion gates, all the drives in sampling units, various pumps of DS/DE systems, service water systems, cooling water system, potable water system and sump pumps, Ventilation Fans. *110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity. *The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train. Gear Box Rating : a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} In any case, gear box rating shall not be less than motor nameplate rating. b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment } @ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues Coupling Not less than motor nameplate rating.			
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4.09.00	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 takeup pulley and takeup weight	Manual for both travel & lift.
4.10.00	Belt Scale Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least ($\pm$) 0.25 percent throughout its range.	
4.11.00	Belting and Pulleys for 1200 TPH a) Belt ratings shall be selected in such a way that there are only three (3) ratings for Nylon/Nylon belting and maximum two (2) ratings of steel cord belting. This however excludes sealing belt (for sealing slots of tripper floor) and belting of belt feeders. (Belting shall be completely interchangeable among same rating of belt.) Minimum number of plies for belting shall be four (4). Other details of belting shall be as specified else where in the specification. b) For Pulley, following minimum parameters shall be followed: (1.) Shell thickness : 20 mm (Min.) (2.) End disc plate thickness : 30 mm(Min.) (3.) Maximum allowable deflection of shaft at hubs : 5 Minutes (4.) Diameter : (i) All drive pulleys : 800 mm dia (min.) 1000 mm dia (min.) (In case of steel cord belts) (ii) All balance pulleys : 630 dia (min) Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP) (a.) Belt ratings shall be selected in such a way that there are only three (3) ratings of belting. This however excludes and belting of belt feeders. Belting shall be completely interchangeable among same rating of belt. (b) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification. (c) For Pulley, following minimum parameters shall be followed:	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		एनटीपीसी NTPC									
	(1.) Maximum allowable deflection of shaft at hubs : 5 Minutes (2.) End disc plate thickness : 12 mm (min.) Shell plate thickness : 12 mm (min.) (3.) Diameter: (i) All drive pulleys : 630 dia (min) (ii) All balance pulleys : 500 dia (min) Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.											
4.12.00	Bulk density of limestone & gypsum shall be considered as follows: <table><thead><tr><th></th><th>Limestone</th><th>Gypsum</th></tr></thead><tbody><tr><td>a) For volumetric computation</td><td>-1400 kg/m³</td><td>900 kg/m³</td></tr><tr><td>b) For load/ strength</td><td>- 1700 kg/m³</td><td>1250 kg/m³</td></tr></tbody></table>				Limestone	Gypsum	a) For volumetric computation	-1400 kg/m ³	900 kg/m ³	b) For load/ strength	- 1700 kg/m ³	1250 kg/m ³
	Limestone	Gypsum										
a) For volumetric computation	-1400 kg/m ³	900 kg/m ³										
b) For load/ strength	- 1700 kg/m ³	1250 kg/m ³										
4.13.00	Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5) nos. These shall comprise of two (2) nos. drive pulleys & three (3) no. for all balance pulleys excluding tripper & SS pulleys.											
4.14.00	The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered). The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days. At least One third (1/3 rd) of total stipulated crushed limestone storage shall be considered in the hopper, if applicable, and hopper length shall be equal to stockpile length placed along the tripper centerline. Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.											
4.15.00	Dust extraction system Type : Dust Extraction System: Dry type with bag filter arrangement for limestone only. Plain water dust suppression system in Gypsum storage shade. Location : Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo.											
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
4.16.00	Service Water System 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. (a.) Flow at each valve : 5 cub.m/hr (b.) Minimum discharge 1. Pressure at tap point : 2 kg/sq.cm 2. No. of valves operated : 6 nos. Simultaneously			
4.17.00	Ventilation System A. Mechanical Ventilation System: i. Underground Areas: Minimum 15 supply air changes and minimum 7 exhaust air changes per hour. ii. Other Areas Minimum 10-supply air changes per hour. B. Pressurized Ventilation System: Minimum 15 supply air changes per hour			
4.18.00	Chutes: Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways) for 1200 mm Belt Width. Minimum clear cross section of chute: 900 mm X 600 mm (inside both ways) for 800 mm Belt Width			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART- A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION-III-A5 LIME STONE & GYPSUM HANDLING PLANT	PAGE 12 OF 12

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(4)-POE-J-001/C) 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 include the Insulating mat for laying in front of 33kV/11kV/6.6kV/3.3kV/415V Switchgears in switchgear rooms under his scope.			
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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(4)-POE-J-001/C and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.			
1.05.00	SWITCHYARD FOR FGUTPP STPP-I,II,III :			
1.05.01	i) The scope of work shall include Design, supply, erection, testing and commissioning of one number 220kV bay in FGUTPP STPP-I,II, III for feeding the FGD Tie Transformer, as per the tender SLD (0011-109(4)-POE-J-001/C, Rev: A associated with FGUTPP STPP Stage-I,II & III. The scope also include extension of existing 220kV bus in space adjacent to existing bay#1A. ii) Scope of work shall also include modification as required at FGUTP STPP Stage-I,II,III Switchyard control room. The existing 220kV switchyard is provided with double main transfer bus scheme. iii) The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacture's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage and equipment erection including associated civil & structure works. Further the scope shall also include cable trenches & its inter connection with existing trenches, cable trays, 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: a) 220kV Equipment: Circuit Breaker, Isolator, Current transformer, Capacitor Voltage Transformer, Surge arresters, Bus Post Insulators etc. II. 220kV Switchyard materials: - EHIPS Aluminum tube			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
1.05.03	- ACSR 'Moose' Conductor - 10.98mm dia G.S. Earthwire - 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 bay 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.			
1.05.04	SWITCHYARD FOR RIHAND STPP-I : i) The scope of work shall include any requirement of clamps & connectors, hard ware, conductors etc if required (as decided during detailed engg.) in existing 132KV Bay for feeding FGD Tie Transformer#1 and Design, supply, erection, testing and commissioning of one number 132kV bay in RIHAND STPP-I,II, III i.e Re-equipment of existing Singrauli line bay (Bay No:11) for feeding the FGD Tie Transformer#2, as per the tender SLD 0011-109(4)-POE-J-001/C, Rev: B associated with Electrical Single line diagram for FGD package RIHAND STPP-1 (Refer Annexure-SLD) ii) The Location of existing 132 KV bay, Re-equip Singrauli line bay marked in General layout plan Drg No:1240-999-POC-F-001, Rev:08 iii) Scope of work shall also include modification as required at RIHAND STPP Stage-I,II,III Switchyard control room. The existing 132kV switchyard is provided with double main scheme. iv) The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacture's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage and equipment erection including associated civil & structure works. Further the scope shall also include cable trenches & its			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	inter connection with existing trenches, cable trays, cabling, lighting, lightning protection, earthing, association of sub vendors in the erection, supervision, site testing, inspection and commissioning. v) Equipment and materials: I) 132kV AIS equipment: a) 132kV Equipment: Circuit Breaker, Isolator, Current transformer, Surge arresters, Bus Post Insulators etc. II) 132kV Switchyard materials: • EHIPS Aluminum tube • Single AAC Bull Conductor • 7/3.66 dia G.S. Earthwire • Insulator and Hardware • Clamps and connectors • Bay Marshaling Kiosks • Material for earthing of all switchyard • equipments and gravel filling Armoured Power and control cables, cabling (including interpole and interpanel), cable trenches, 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. vi) The equipment and materials to be supplied by the Contractor shall form a complete 132kV AIS bay 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.			
1.05.05	SWITCHYARD FOR VINDYACHAL STPP-I & II : The scope of work shall include any requirement of clamps & connectors, hard ware, conductor s etc if required (as decided during detailed engineering) in existing 132kV bays to match with the FGD Tie Transformers is in the scope of bidder as per the tender SLD (0011-109 (4)-POE-J-001/C, Rev: A associated with Vindyachal stage-I & II FGD package.			
1.05.06	SWITCHYARD FOR KAHALGAON STPP-STAGE-I & II : The scope of work shall include any requirement of clamps & connectors, hard ware, conductor etc if required (as decided during detailed engineering) in existing 132KV bays to match with the FGD Tie Transformers is in the scope of bidder as per the tender SLD (0011-109(4)-POE-J-001/C, Rev: A associated with Khahalgaon stage-I & II FGD package.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
1.05.07	SWITCHYARD FOR SINGRAULI STPP-I & II :			
	The scope of work shall include any requirement of clamps & connectors, hard ware, conductor etc if required (as decided during detailed engineering) in existing 132KV bays to match with the FGD Tie Transformers is in the scope of bidder as per the tender SLD (0011-109(4)-POE-J-001/C, Rev: A associated with Singrauli stage-I & II FGD package.			
1.05.08	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. 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.			
1.06.00	(A) Control & Protection of EHV system for new bays a) Control and protection of new 220KV /132KV Bays and 220/34.5kV, 132KV/34.5 FGD Tie Transformers as per the Tender SLD, REV:B for FGD system. Protection system shall be provided with Numerical relays. (Refer Annexure- SLD) 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 bar protection 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. 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.			
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	h) Recommended relay setting and SCD/ICD files for owner's review and approval. (B) Control & Protection of EHV bays wherever new FGD Tie Transformer are to be provided a) Bidder shall check the existing protection system and provide additional protections if required with respect to tender SLD. New Protection system shall be provided with Numerical relays and must comply with the NTPC Technical specification. Scope of work shall also include: Extending AC/DC supply from owner's existing ACDB/DCDB in switchyard area for the new relays Relay protection panels for new relays, integration with existing SOE (sequence of event) system, Relay test kit as per specification b) It is in the interest of the bidder to acquaint himself with the existing schematics and present scope before submission of offer. c) All control cables within switchyard, interface for transformers and switchyard and main plant for the realization of control and protection scheme. d) Recommended relay setting and SCD/ICD files for owner's review and approval.			
1.07.00	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).			
1.08.00	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 (4)-POE-J-001/C.			
1.09.00	DG SET (IF APPLICABLE) Diesel Generator sets of stationary type comprising the following: (1.) Diesel Engine Complete with all accessories			
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1.10.00	(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 (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 1) 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. 2) Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109 (4)-POE-J-001/C 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. 3) Contractor shall supply, lay and terminate the cables under his scope of supply 4) 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.			
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1.11.00	5) Contractor shall provide cable glands and lugs for all equipment's in his scope. 6) 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. 7) 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. 8) Contractor shall provide Galvanised steel pipes/HDPE/hume pipes/PVC pipes, Miscellaneous items like M.S sections etc as required, 9) Contractor shall provide Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc 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 FGD system 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.			
	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.			
	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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(4)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 8 OF 13

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.14.00	CONSTRUCTION POWER To meet the construction power requirement of the complete FGD and associated , the Employer shall provide Two Number 415V feeders in LT switchgears in each stage, power drawal limited to 400KVA from each feeder. In case total construction power requirement is more than 800kVA, Contractor may use one of the Owner's existing HT feeders proposed to be used for FGD, the modification of which is in scope of Contractor as per Tender SLD. 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 for type of connection(HT/LT). 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.			
1.17.00	<u>Kahalgaon STPP Stage-I and II</u>			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(4)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 9 OF 13

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	1) Bidder shall replace existing Makeup transformers #1 & 2 located in switchyard area with 132/34.5kV FGD Tie transformers of rating as indicated in relevant tender SLD for deriving power for FGD system from existing 132kV bays. Any modifications required in switchyard/Protection scheme for this purpose shall be in bidder's scope. Civil works for the new transformers shall also be in bidder's scope. 2) Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. Two nos. 33kV feeders from this switchgear shall be provided for feeding of existing makeup water lines which are presently being fed through existing makeup water transformers. 3) All additional equipments, miscellaneous items (clamps, connectors, cables, cabling etc. as required) and associated erection and civil works for smooth transfer of feeding of existing makeup water lines to new 33kV FGD switchgear shall be in scope of bidder. 4) Dismantling and relocation of existing makeup water transformers to location as directed by site in charge shall be in bidder's scope. <u>FGUTPP stage-I, II and III</u> 1) One number new 220kV bay shall be implemented by bidder adjacent to existing Raibareli line bay (i.e. bay No:1A) in 220kV generation switchyard of FGUTPP. 220/34.5kV FGD Tie transformers#1 of rating as indicated in relevant tender SLD for deriving power for FGD system from 220kV voltage level shall be provided. All Civil works for the entire new bay and for the new transformers shall be in bidder's scope. 2) Dismantling of existing switchyard peripheral road & its re- construction along new bay and its inter connection with existing road , dismantling of existing fencing and its re- construction along new bay 3) Bidder shall replace the existing solar power transformer located in 220kV switchyard area with 220/34.5kV FGD Tie transformers#2 of rating as indicated in relevant tender SLD for deriving power for FGD system from existing 220kV voltage bay. Any modifications required in switchyard/Protection scheme for this purpose shall be in bidder's scope. Civil works for the new transformers shall also be in bidder's scope. 4) Control and protection of new 220kV Bay and 220/34.5kV FGD Tie Transformers as per the Tender SLD for FGD system and any modifications required in switchyard / existing protection scheme for this purpose shall be in bidder's scope.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(4)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 10 OF 13	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	5) Bidder shall create new 33kV FGD tie switchgear in switchyard area from above two sources which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. One nos. 33kV feeders shall be provided in this switchgear for connection with solar plant incoming cable. 6) All additional equipments, miscellaneous items (cables, cabling etc. as required) and associated erection and civil works for interconnection of 33kV solar supply feeder to the new 33kV switchgear shall be in scope of bidder. 7) Dismantling and relocation of existing solar transformer to location as directed by site in charge shall be in bidder's scope. <u>Singrauli STPP Stage-I and II</u> 1) Bidder shall replace existing Colony Transformer #1 & 2 located in switchyard area with 132/34.5kV FGD Tie transformers of rating as indicated in relevant tender SLD for deriving power for FGD system from existing 132kV bays. Any modifications required in switchyard/Protection scheme for this purpose shall be in bidder's scope. Civil works for the new transformers shall also be in bidder's scope. 2) Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. Two nos. 33kV feeders shall be provided from this switchgear for feeding of 33/11.5kV miscellaneous service transformer of ratings as indicated in relevant tender SLD (HT Trf#5 &6). These transformers shall be in scope of bidder and shall be used for feeding of employers existing 11kV colony switchgear. 3) All additional equipments, miscellaneous items (cables, cabling etc. as required) and associated erection and civil works for smooth transfer of supply source of 11kV miscellaneous switchgear to new 33/11.5kV transformers shall be in scope of bidder. Any modification required in the incomers of existing switchgear shall also be in bidder's scope. 4) Dismantling and relocation of existing Colony transformers to location as directed by site in charge shall be in bidder's scope. <u>Rihand STPP Stage-I</u> 1) Bidder shall replace existing 12.5MVA Transformer located in 132kV switchyard area with 132/34.5kV FGD Tie transformer#1 of rating as indicated in relevant tender SLD. Bidder shall re-equip 132kV Singrauli line bay at Rihand 132kV switchyard and use it to derive power for FGD system from through 132/34.5kV FGD Tie Transformer#2. Any modifications required in switchyard/existing Protection scheme for this purpose shall be in bidder's scope. All Civil works for the entire new bay including dismantling of existing equipment foundations & any facilities shall be in bidder's scope. Civil works for the new transformers shall also be in bidder's scope.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(4)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 11 OF 13

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
	2) Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. One nos. 33kV feeders shall be provided from this switchgear for feeding of 33/11.5kV miscellaneous service transformer of ratings as indicated in relevant tender SLD. This transformers shall be in scope of bidder and shall be used for feeding of employers existing 11kV miscellaneous/colony switchgear. 3) All additional equipments, miscellaneous items (cables, cabling etc. as required) and associated erection and civil works for smooth transfer of supply source of 11kV miscellaneous switchgear to new 33/11.5kV transformer shall be in scope of bidder. Any modification required in the incomers of existing switchgear shall also be in bidder's scope. 4) Dismantling and relocation of existing 12.5 MVA transformers and existing line equipment of Singrauli-Rihand 132 KV line bay to location as directed by site in charge shall be in bidder's scope. <u>Farakka STPP Stage-I, II & III</u> 1) Bidder shall utilize two number of SPARE feeders in EXISTING STAGE-III 33 KV switchgear located in switchyard area for deriving power for FGD system as indicated in relevant tender SLD. Any augmentation/modification required in the SPARE feeders of existing switchgear shall also be in bidder's scope. Any modifications required in switchyard/Protection scheme for the same shall be in bidder's scope. 2) Bidder shall create new 33kV FGD tie switchgear in switchyard area near the existing 33kV stage-III switchgear. The new switchgear shall be located in NEW 33 kV SWITCHGEAR BUILDING, also in Bidders scope. 3) All additional equipments, miscellaneous items (cables, cabling etc. as required) and associated erection and civil works shall be in scope of bidder. 4) Two number feeders (transformer feeders suitable for 2.5MVA transformer) shall be provided in 6.6kV FGD switchgear of stage-III for owners use in addition to the spares indicated in technical specification. Total load of 2MVA shall be considered over and above FGD loads for sizing of upstream feeding system (cable, transformer, busduct) on account of this owners load.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOC NO:CS-CS-0011-109(4)-9	PART-A SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	PAGE 12 OF 13

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	Unitted /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	Unitted/Station	U	Unit(U) is applied for each unit.								
		S	STN(S) is applied for common equipment load.								
7	Normal / Emergency	N	Normal Supply								
		E	Emergency Supply(Emergency supply i.e DG supply)								
8	Feeder type	U	Unidirectional Motor feeder								
		B	Bidirectional Motor feeder								
		H	Heater feeder								
		S	SFU(switch fuse feeder)								
9	Running Mode	W	Working								
		S	Standby								
10	Recommended cable size	-/-/-/-/-	Recommended Incoming power cable size in: No of runs/no. of cores/ Size in mm2/Al or Cu/ PVC or XLPE								
11	Location		Location of the Equipment in coordinates row & columns as per layout								
12	Remarks		Any other relevant information								
Notes:											
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.											

CLAUSE NO.

SCOPE OF SUPPLY & SERVICES

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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 1 OF 21	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
1.02.00 1.02.01	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 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 except for Booster Fan blade pitch controls for which conventional controls and devices (Actuators, Instruments) shall be provided 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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 2 OF 21	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
1.02.02	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. 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. Also refer Annexure IIIC-05K for fieldbus components. E. For High torque (> 1000 Nm) electric actuators: Contractor may propose non-intrusive fieldbus electrical actuators without SIL2 certification. The detailed reasoning and justification for proposed type of actuators shall be furnished by Contractor at the start of detailed engineering. This shall be reviewed & discussed with Contractor and after Employer's approval, the alternate type of non-intrusive actuators can be provided by the Contractor. F. Contractor shall provide Configuration/ Diagnostic tools for fieldbus (FF/ Profibus) network/ devices as below : • Configuration/ diagnostic tool (if applicable) for non-intrusive actuators - 5 Nos. or 5% of total quantity of actuator whichever is more. • Configuration/ diagnostic tool for all Foundation Fieldbus based instruments – 2 Nos of each make. • Configuration/ diagnostic tool for Profibus network like Profitrace/ Profibus modem – 2 nos. for DDCMIS. Contractor shall provide all required software (lifetime licensed) and hardware (cables/ connectors, Tablet/ Laptop etc.) along with these tools. G. Twisted pair with round steel wired armour (SWA), Type A fieldbus cable complying to IEC 61158 (detailed Specification as per PART-B), Fieldbus JB's of SS 316 with IP-66 and accessories for fieldbus based instruments and actuators shall be provided by the contractor under this package. The redundancy in sensor, cable, control system component, power supply system component shall be designed by the Contractor to ensure that malfunction of any single sensor/ cable / Control system component/ power supply system component etc. shall not lead to loss of any Major Auxiliary (all HT Drives and Critical LT drives) or loss of Generation or loss of control function or loss of protection function. Contractor shall also ensure that Loss/ Malfunction of any single sensor shall not jeopardize the safety of the equipment		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 3 OF 21

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
2.00.00 2.01.00 2.02.00 2.02.01	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS) 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. Flue Gas De Sulphurization (FGD) DDCMIS 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 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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 4 OF 21	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	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. 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.			
2.04.00	Human - Machine Interface & Plant Information System (HMIPIS)			
2.04.01	HMIPIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC/TCP/IP protocols, etc. shall be provided.			
2.04.02	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.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 5 OF 21

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	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. 2.04.03 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, creation of DMZ zone in the firewall etc. 2.04.04 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. 2.04.05 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, SUB-SECTION-IIIC-02 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 checked for and carried out six months before the completion of AMS of last DDCMIS (whose AMS started last). Any change in hardware and the requisite services (Engineering/Erection/Commissioning/Documentation) required for the same shall also be carried out by the contractor within the contract price 2.04.06 The DDCMIS OEM shall ensure sanctity of the application software & firmware before the same is dispatch to site. The intent is to have a mechanism to verify that the application software & firmware (excluding third party software) does not contain any malicious code or otherwise is not operating contrary to its stated purpose. The verification needs to be carried out electronically using one of the following methods: (i) Digital Certificates (ii) Digital Signatures			
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	(iii) Dongle based authentication/verification - Software licenses provided through dongles shall not be accepted as verification for the purpose. (iv) Other electronics means of verification as agreed and accepted by the Employer during detailed engineering. The same shall be carried out at the time of FAT of each DDCMIS and on every software & firmware upgrade, update and patch application. This shall be applicable and performed for all types of application software & firmware applicable for a particular DDCMIS. Other details/procedure/modalities, as applicable, shall be finalized during detailed engineering. The DDCMIS OEM shall also be required to certify that no backdoor has been engineered in the application software and firmware (including the control hardware excluding Bought-outs) being supplied for the project. Such certificate shall be furnished for all batches of hardware (including firmware)/software manufactured and supplied for the project by the DDCMIS OEM. 2.04.07 The system shall comply with the latest versions of the following standards and specifications as a minimum: 1. IEC-62443-4-2 Security for industrial automation and control systems - Part 4-2: Technical security requirements for IACS components. 2. IEC 62443-2-4:2015 Security for industrial automation and control systems - Part 2-4: Security program requirements for IACS service providers 2.05.00 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. 2.06.00 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. 2.07.00 Annunciation Function The annunciation system shall be built as a part of the control system of the DDCMIS.			
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2.08.00 2.08.01 2.08.02 2.09.00 2.10.00	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 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,			
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	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. 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.			
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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 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:			
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	(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 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			
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3.03.00	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.																																																	
3.03.01	CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) 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. A) LIST OF FLUE GAS EMISSION ANALYSERS FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) <table><tr><th>S. No.</th><th>KKS CODE</th><th>DESCRIPTION</th><th>RANGE</th><th>ZONE</th><th>REMARK</th></tr><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></table> NOTES: 1. 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. 2. 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. 3. 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	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																																													
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	standard/reference O2. 4. 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. 5. CO2 Measurement at stack and at instrument end shall be provided in case dilution techniques are used. 6. 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 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 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. 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.			
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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			
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.			
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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 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			
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5.00.00	provided and design of canopy shall be approved by Employer during detailed engineering.			
5.01.00	INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS			
	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.		
	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.			
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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. 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.			
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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.			
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.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																						
13.00.00	If electric actuator requires any additional power supply/ signal for its operation complying to specification requirements, then required power supply, cabling and termination etc. shall be provided by the contractor. 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.																						
	CONTROL DESK, PANELS AND FURNITURES																						
	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: <table><tr><td>a)</td><td>Chair</td><td>-</td><td>3 nos.</td></tr><tr><td>b)</td><td>Printer table</td><td>-</td><td>1 no</td></tr><tr><td>c)</td><td>Computer table</td><td>-</td><td>2 no.</td></tr><tr><td>d)</td><td>Key pad</td><td>-</td><td>1 no.</td></tr><tr><td>e)</td><td>Locker set</td><td>-</td><td>1 no</td></tr></table> Server rack (to accommodate all servers / workstations in Unit CER, their mini UPS, matrix KVM Switches), PC rack and workstation furniture shall be provided on as required basis.				a)	Chair	-	3 nos.	b)	Printer table	-	1 no	c)	Computer table	-	2 no.	d)	Key pad	-	1 no.	e)	Locker set	-
a)	Chair	-	3 nos.																				
b)	Printer table	-	1 no																				
c)	Computer table	-	2 no.																				
d)	Key pad	-	1 no.																				
e)	Locker set	-	1 no																				
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 19 OF 21																			

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
14.00.00 14.01.00	SCOPE OF SERVICES 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. - 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. - Engineering of power supply system for DDCMIS, Process connection and piping, Control valves etc. - Instrumentation, cable engineering including preparation of interconnection cable diagram, cable schedule etc. - The contractor shall deploy certified and experienced engineers in the system design of fieldbus during engineering and commissioning of fieldbus 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. 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: - Inter panel spacing-1200 mm			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	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		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-III-C C&I SYSTEM	PAGE 21 OF 21

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 absorber) 5 (applicable for project with two absorber) 6 (applicable for project with three absorber) 7 (applicable for project with four absorber)	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. Interconencting 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	एनटीपीसी NTPC		
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.			
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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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-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.					
1.03.00	Equipment Cooling Water					
	SI No	Project / Stage	Process water	Gypsum Wash Water (Clarified Water)	Normal make up to ECW tank	Emergency make up to ECW tank
	1	FGUTPP- I (2 X 210 MW)	Shall be tapped from clarified water tank of FGUTPP ST-I.		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 normal	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.
	2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)	Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.		
	3	Farakka-I (3 X 200 MW)	Shall be tap off suitably from clarified water tank of Farakka STPP ST-I.			
	4	Farakka- II (2 X 500 MW)	Shall be tap off suitably from from service water tank of Farakka STPP ST-II.			
	5	Farakka-III (1 X 500 MW)	Shall be tap off suitably from the existing blow down	Shall be tap off suitably from the existing HVAC header (HVAC make up		
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9		TERMINAL POINTS & EXCLUSIONS		

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS				एनटीपीसी NTPC	
			header available near FGD area of Farakka STPP ST-III.	pump discharge) available near C-row of Farakka STPP ST-III.	makeup water requirement.	
	6	Kahalgaon-I (4x 210 MW)	Water shall be pumped from suitable location of stage-I CW OAC.	Shall be tap off suitably from the existing AC cooling storage tank at stage- I.		
	7	Kahalgaon-II (3x 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP ST- II.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Kahalgaon STPP ST-II.		
	8	Singrauli-I (5 x200 MW)	Tap off suitably from clarified water tank of Singrauli-I.			
	9	Singrauli-II (2 x500 MW)	Tap off suitably from clarified water tank of Singrauli-II.			
	10	Rihand-I (2 X 500 MW)	Tap off suitably from clarified water tank of Rihand-stage-II.			
		Note- (1) Gypsum Wash Water (Clarified Water) quantity available at TP will be 0.015m3/hr /MW. (2) Maximum quantity of Normal make up water to ECW tank of ECW system will be 2m3/hr. (3) Maximum quantity of Emergency make up to ECW tank of ECW system will be 2m3/hr.				
	1.04.00	Not used				
	1.05.00	Not used				
	1.06.00	Not used				
	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 FGD area.				
	1.08.00	Waste Water FGD waste water and LHP/GHP waste water shall be sent to ash slurry sump. Lime neutralization of FGD waste water shall be done before sending it to ash slurry sump.				
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CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS 	
	Bidder shall indicate the anticipated range of chloride content in the waste water at terminal point.	
1.09.00	Limestone For unloading with Road-Truck Unloading System, entry to truck unloading area.	
1.10.00	Gypsum Outlet of Gypsum storage silo/shed	
1.11.00	FIRE DETECTION AND PROTECTION SYSTEM (i) Mechanical: Separate Hydrant and spray header (within 100 metre) available in plant area for tapping required for Hydrant and spray system for FGD/ZLD 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 220kV Switchyard (For FGUTPP only) iii) Employer 132kV bays at 132kV switchyard (For RIHAND , Kahalgaon & Singrauli 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	
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SUB-SECTION-V

SALIENT DESIGN DATA

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC																																																																	
1.00.00 2.00.00 A	DELETED The Flue Gas Desulphurisation (FGD) System for Farakka-II & III (2 x 500 MW + 1 x 500 MW), Singrauli-II (2 x 500 MW), &Rihand-I (2 x 500 MW) shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below: <table border="1"> <thead> <tr> <th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr> </thead> <tbody> <tr> <td>1</td><td>Boiler Load in MW (e)</td><td>500</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>417</td><td>440</td></tr> <tr> <td>5</td><td>Gas flow at the FGD inlet when firing respective coal (Nm³/sec)*</td><td>565 (870 m³/s)</td><td>616 (982 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></td><td>(i) O₂ (% v/v wet)</td><td>6.282</td><td>6.064</td></tr> <tr> <td></td><td>(ii) CO₂ (% v/v wet)</td><td>10.491</td><td>10.139</td></tr> <tr> <td></td><td>(iii) H₂O (% v/v wet)</td><td>12.096</td><td>15.075</td></tr> <tr> <td></td><td>(iv) SO₂ (% v/v wet)</td><td>0.071</td><td>0.068</td></tr> <tr> <td></td><td>(v) N₂ (% v/v wet)</td><td>71.061</td><td>68.653</td></tr> <tr> <td></td><td>(vi) Inlet SO₂ (mg/Nm³-wet) 2025</td><td></td><td>1957</td></tr> <tr> <td></td><td>(vii) Dust (mg/Nm³)</td><td>50</td><td>200</td></tr> <tr> <td></td><td>(viii) SO₃ (ppm)</td><td>10.5</td><td>10.2</td></tr> </tbody> </table>	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)	417	440	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	565 (870 m ³ /s)	616 (982 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)	6.282	6.064		(ii) CO ₂ (% v/v wet)	10.491	10.139		(iii) H ₂ O (% v/v wet)	12.096	15.075		(iv) SO ₂ (% v/v wet)	0.071	0.068		(v) N ₂ (% v/v wet)	71.061	68.653		(vi) Inlet SO ₂ (mg/Nm ³ -wet) 2025		1957		(vii) Dust (mg/Nm ³)	50	200		(viii) SO ₃ (ppm)	10.5	10.2		
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3.00.00 B	The Flue Gas Desulphurisation (FGD) System for Kahalgaon St-I (2 x 210 MW + 2 x 210 MW) shall be combined together (combination of maximum 2 units) and shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below: <table border="1"> <thead> <tr> <th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr> </thead> <tbody> <tr> <td>1</td><td>Boiler Load in MW (e)</td><td>2 x 210</td><td>2 x 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>412</td><td>440</td></tr> <tr> <td>5 A</td><td>Gas flow at the FGD inlet when firing respective coal (Nm³/sec)*</td><td>431 (644 m³/s)</td><td>477 (744 m³/s)</td></tr> <tr> <td>5 B</td><td>Gas flow at the FGD bypass when firing respective coal (Nm³/sec). FGD by pass duct system shall be designed considering 40% flue gas flow of the Total flue gas entering at the inlet of FGD system*</td><td>108 (161 m³/s)</td><td>119 (186 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>Flue Gas Composition at FGD system inlet:</td><td></td><td></td></tr> <tr> <td></td><td>(i) O₂ (% v/v wet)</td><td>6.19</td><td>5.98</td></tr> <tr> <td></td><td>(ii) CO₂ (% v/v wet)</td><td>9.84</td><td>9.52</td></tr> <tr> <td></td><td>(iii) H₂O (% v/v wet)</td><td>13.633</td><td>16.492</td></tr> <tr> <td></td><td>(iv) SO₂ (% v/v wet)</td><td>0.044</td><td>0.042</td></tr> <tr> <td></td><td>(v) N₂ (% v/v wet)</td><td>67.97</td><td>67.97</td></tr> </tbody> </table>	Sl. No	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	2 x 210	2 x 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)	412	440	5 A	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	431 (644 m ³ /s)	477 (744 m ³ /s)	5 B	Gas flow at the FGD bypass when firing respective coal (Nm ³ /sec). FGD by pass duct system shall be designed considering 40% flue gas flow of the Total flue gas entering at the inlet of FGD system*	108 (161 m ³ /s)	119 (186 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)	6.19	5.98		(ii) CO ₂ (% v/v wet)	9.84	9.52		(iii) H ₂ O (% v/v wet)	13.633	16.492		(iv) SO ₂ (% v/v wet)	0.044	0.042		(v) N ₂ (% v/v wet)	67.97	67.97		
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3.00.00 C	The Flue Gas Desulphurisation (FGD) System for Unchahar-II & III (2 x 210 MW + 1 x 210 MW), Farakka St-I (3 x 200 MW), Singrauli St-I (3 x 200 MW), shall be combined together (combination of maximum 3 units) and shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below: <table border="1"> <thead> <tr> <th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr> </thead> <tbody> <tr> <td>1</td><td>Boiler Load in MW (e)</td><td>3 x 200 / 210</td><td>3 x 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>591</td><td>660</td></tr> <tr> <td>5</td><td>Gas flow at the FGD inlet when firing respective coal (Nm³/sec)*</td><td>774 (1167 m³/s)</td><td>894 (1395 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></td><td>(i) O₂ (% v/v wet)</td><td>6.282</td><td>6.064</td></tr> <tr> <td></td><td>(ii) CO₂ (% v/v wet)</td><td>10.491</td><td>10.139</td></tr> <tr> <td></td><td>(iii) H₂O (% v/v wet)</td><td>12.096</td><td>15.075</td></tr> <tr> <td></td><td>(iv) SO₂ (% v/v wet)</td><td>0.071</td><td>0.068</td></tr> <tr> <td></td><td>(v) N₂ (% v/v wet)</td><td>71.061</td><td>68.653</td></tr> <tr> <td></td><td>(vi) Inlet SO₂ (mg/Nm³-wet)</td><td>2025</td><td>1957</td></tr> <tr> <td></td><td>(vii) Dust (mg/Nm³)</td><td>50</td><td>200</td></tr> <tr> <td></td><td>(viii) SO₃ (ppm)</td><td>10.50</td><td>10.20</td></tr> </tbody> </table>	Sl. No	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	3 x 200 / 210	3 x 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)	591	660	5	Gas flow at the FGD inlet when firing respective coal (Nm ³ /sec)*	774 (1167 m ³ /s)	894 (1395 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)	6.282	6.064		(ii) CO ₂ (% v/v wet)	10.491	10.139		(iii) H ₂ O (% v/v wet)	12.096	15.075		(iv) SO ₂ (% v/v wet)	0.071	0.068		(v) N ₂ (% v/v wet)	71.061	68.653		(vi) Inlet SO ₂ (mg/Nm ³ -wet)	2025	1957		(vii) Dust (mg/Nm ³)	50	200		(viii) SO ₃ (ppm)	10.50	10.20		
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	(ix) HCl (ppm)-wet	45	45	
	(x) HF (ppm)-wet	12	12	
	8 SO ₂ removal Efficiency (Continuous) (%) (mim)	9292		
	9 Limestone Consumption (kg/hr) (max)	10100	-	
	10 Unit Auxiliary Power Consumption (KW) Unchahar Farakka Singrauli	Unit Auxiliary Power Consumption (KW) for complete scope of work for the project (max.)	5670	
	11 Chimney Height (m)	Single Flue	225	
	* The flue gas volume in Nm³/sec shall be calculated at 101.325 kPa and 273.15 K. ** Pressure at Terminal Point before Booster Fan Suction shall be Zero (0) mmwc at Guarantee Point Condition for all the projects			
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. Chimney at the top of the absorber is not permitted. 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			
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4.01.04	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.									
	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 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.									
	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 mini-mum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness. The minimum length of flue liner project-ing over the chimney roof shall be atleast equal to diameter of flue liner.									
4.01.05	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 fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner									
4.01.06	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.									
4.01.07	The chimney liner & duct shall be designed & sized considering the following requirements as a minimum.									
4.01.08	<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></table>				SN	Item	Chimney Sizing Condition	1	Boiler Load in MW (e)	TMCR Worst Coal (Guarantee Point)
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4.02.00	<table><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>	2	Gas flow at Chimney Inlet (M ³ /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	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	
2	Gas flow at Chimney Inlet (M ³ /sec)	To be worked out considering Guarantee Point condition										
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4	Flue Gas velocity (m/s) inside Chimney	< 16.8 for Titanium / C-276 Lining < 18.3 for Borosilicate Lining										
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.											
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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: *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%. - 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			
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6.00.00	kg/m³for 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 ± (plus or minus) 1 deg. C and relative humidity of 50% ± (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.			
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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: 2 X 100% b) (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 c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 15 OF 23	

CLAUSE NO.	SALIENT DESIGN DATA														
6.03.00	DESIGN PHILOSOPHY – Ventilation System 1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows: <table border="0" style="margin-left: 40px;"> <tr> <td>i)</td><td>For all evaporative cooled areas</td><td style="text-align: center;">-</td><td style="text-align: center;">8</td></tr> <tr> <td>ii)</td><td>General areas</td><td style="text-align: center;">-</td><td style="text-align: center;">20</td></tr> <tr> <td>iii)</td><td>MCC / Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated</td><td style="text-align: center;">-</td><td style="text-align: center;">30</td></tr> </table> 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 (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	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		
i)	For all evaporative cooled areas	-	8												
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iii)	MCC / Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated	-	30												
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA PAGE 16 OF 23												

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC		
	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. 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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 17 OF 23	

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)
Farakka	Summer	41	25.5
	Monsoon	34.5	27.5
	Winter	15	10
Kahalgaon	Summer	43	27.5
	Monsoon	38	29
	Winter	6.5	5.5
Singrauli	Summer	43.5	25.5
	Monsoon	38	27.5
	Winter	15	10
Rihand	Summer	43.9	25.6
	Monsoon	35	28.9
	Winter	8.9	7.2
Unchahar	Summer	43.9	25.6
	Monsoon	35	28.9
	Winter	8.9	7.2

CLAUSE NO.	SALIENT DESIGN DATA			
7.00.00	Fire Detection and Protection System			
7.01.00	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.			
7.02.00	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.			
	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 hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification.			
	v) Isolation valves (Gate Valves) shall be provided in each of the ring mains / sub-loops to enable to take up part of any of the ring mains for maintenance without any loss of system in the balance part.			
	vi) An isolation valve (Gate Valves) shall be provided in feeder & terminal pipes serving three or more hydrants or water monitors or in case the terminal length is 15 meters or more with a single/two hydrant valve. Each ring main shall be terminated with an isolation valve (Gate Valve) with a blind flange at all corners to enable future expansion/ modification by Employer.			
	vii) Hydrant risers in staircases shall be provided with isolation valves (Gate Valves).			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 19 OF 23

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC		
7.03.00	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. There shall also be a provision to operate deluge valve electrically from a nearby local panel. viii) Material of construction for projectors / spray nozzles shall be Stainless Steel. Pressure gauges and pressure switches at upstream and downstream of deluge valves shall be provided. ix) An isolation valve (Gate Valve) with limit switch shall be provided at both upstream and downstream of each of the deluge valve. The size shall be same as that of the deluge valve.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 20 OF 23	

CLAUSE NO.	SALIENT DESIGN DATA	एनडीपीसी NTPC	
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 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.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA PAGE 21 OF 23

CLAUSE NO.	SALIENT DESIGN DATA		एनडीपीसी NTPC															
8.01.00 a)	Selection of Capacity of Air Compressor 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><thead><tr><th>Sl. No.</th><th>Continuous Requirement</th><th>Quantity (in NM³/min)</th></tr></thead><tbody><tr><td>1.</td><td>Instrument air requirement for FGD plant (Continuous)</td><td>A</td></tr><tr><td>2.</td><td>Service air requirement for FGD plant</td><td>B</td></tr><tr><td>3.</td><td>Total Air requirement</td><td>= A+B</td></tr><tr><td>4.</td><td>Capacity of air compressor</td><td>= 2(A+B)</td></tr></tbody></table> 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. 1. 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". 2. 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. 3. The discharge pressure of compressor shall be minimum 8.5 Kg/cm² (g). 4. 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. 5. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C. 6. 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. 7. Parallel operation of compressors shall be possible without any undue vibration and noise.			Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)	1.	Instrument air requirement for FGD plant (Continuous)	A	2.	Service air requirement for FGD plant	B	3.	Total Air requirement	= A+B	4.	Capacity of air compressor	= 2(A+B)
Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)																
1.	Instrument air requirement for FGD plant (Continuous)	A																
2.	Service air requirement for FGD plant	B																
3.	Total Air requirement	= A+B																
4.	Capacity of air compressor	= 2(A+B)																
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA PAGE 22 OF 23															

CLAUSE NO.	SALIENT DESIGN DATA 		
9.00.00 9.01.00	8. 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. 9. 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. LIMESTONE AND GYPSUM HANDLING PLANTS Refer Part-B section-I M6 of technical specification.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 23 OF 23

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-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 1 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
2.02.00	Test Instrumentation, Flow Measurement and their Calibration			
2.02.01	All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost. The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.			
2.02.02	The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.			
2.02.03	The Contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following: (a) Object of the test. (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction calculations & curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 2 OF 25

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 for unit capacity of 500 MW. For 200 MW / 210 MW units where common absorber has been specified for two / three units based on scope of supply, LD values are applicable for combination of units as indicated in the clause 3.00.00 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.			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>FARAKKA- II & III (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 2,478,208 /- (INR Two Million Four Hundred Seventy Eight Thousand Two Hundred Eight only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.
	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 24,858,184 /- (INR Twenty Four Million Eight Hundred Fifty Eight Thousand One Hundred Eighty Four 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 143,944 /- (INR One Hundred Forty Three Thousand Nine Hundred Forty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>FARAKKA- I (3X200 MW) Common FGD system</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 3,680,595/- (INR Three Million Six Hundred Eighty Thousand Five Hundred Ninety Five 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 20,812,843 /- (INR Twenty Million Eight Hundred Twelve Thousand Eight Hundred Forty 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 143,944/- (INR One Hundred Forty Three Thousand Nine Hundred Forty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 6 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>KAHALGAON - II (3X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,558,150 /- (INR Two Million Five Hundred Fifty Eight Thousand One Hundred Fifty 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 143,944 /- (INR One Hundred Forty Three Thousand Nine Hundred Forty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>KAHALGAON - IA [(2X210 MW) Common FGD system]</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,182,670 /- (INR Two Million One Hundred Eighty Two Thousand Six Hundred Seventy 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 21,118,247 /- (INR Twenty One Million One Hundred Eighteen Thousand Two Hundred Forty 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 143944 /- (INR One Hundred Forty Three Thousand Nine Hundred Forty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 8 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>KAHALGAON - IB [(2X210 MW) Common FGD system]</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,182,670 /- (INR Two Million One Hundred Eighty Two Thousand Six Hundred Seventy 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 21,118,247 /- (INR Twenty One Million One Hundred Eighteen Thousand Two Hundred Forty 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 143944 /- (INR One Hundred Forty Three Thousand Nine Hundred Forty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>SINGRAULI - II (2X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,500,531 /- (INR Two Million Five Hundred Thousand Five Hundred Thirty One 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 2,0215,220 /- (INR Twenty Million Two Hundred Fifteen Thousand Two Hundred Twenty 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 185,040 /- (INR One Hundred Eighty Five Thousand Forty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 10 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>SINGRAULI - I (2X200 MW) Common FGD system</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,595,167 /- (INR Two Million Five Hundred Ninety Five Thousand One Hundred Sixty Seven 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 20,611,698/- (INR Twenty Million Six Hundred Eleven Thousand Six Hundred Ninety Eight 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 185040/- (INR One Hundred Eighty Five Thousand Forty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>SINGRAULI - I (3X200 MW) Common FGD system</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 3,633,561/- (INR Three Million Six Hundred Thirty Three Thousand Five Hundred Sixty One 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 20,412,496/- (INR Twenty Million Four Hundred Twelve Thousand Four Hundred Ninety Six 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 185,040/- (INR One Hundred Eighty Five Thousand Forty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 12 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>RIHAND- I (2X500 MW)</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,517,846/- (INR Two Million Five Hundred Seventeen Thousand Eight Hundred Forty Six 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 21,118,247/- (INR Twenty One Million One Hundred Eighteen Thousand Two Hundred Forty 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 164,651/- (INR One Hundred Sixty Four Thousand Six Hundred Fifty One only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 13 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>FGUTPP - I (2X210 MW) Common FGD system</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,674,537/- (INR Two Million Six Hundred Seventy Four Thousand Five Hundred Thirty Seven 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 20,812,843/- (INR Twenty Million Eight Hundred Twelve Thousand Eight Hundred Forty 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 251,794/- (INR Two Hundred Fifty One Thousand Seven Hundred Ninety Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 14 OF 25

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<u>FGUTPP - I (3X210 MW) Common FGD system</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	SO2 Removal Efficiency For shortfall in guaranteed SO2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 3,739,310/- (INR Three Million Seven Hundred Thirty Nine Thousand Three Hundred Ten 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 21,118,247/- (INR Twenty One Million One Hundred Eighteen Thousand Two Hundred Forty 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 251,794/- (INR Two Hundred Fifty One Thousand Seven Hundred Ninety Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
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	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 for unit capacity of 500 MW. For 200 MW / 210 MW units common absorber has been specified for two / three units based on scope of supply and LD values are applicable for combination of units as indicated in the clause 3.00.00			
4.00.00	GUARANTEES PARAMETERS			
4.01.00	Guarantees Under Category-I The Performance Guarantees which attract Liquidated Damages (LD) are as follows: The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI: (i) SO₂ removal Efficiency The Contractor shall guarantee that SO₂ removal efficiency shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.) (ii) Limestone Consumption The Contractor shall guarantee that limestone consumption of FGD system in kg/hr shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (iii) Auxiliary Power Consumption The Contractor shall guarantee that total auxiliary power consumption for the unit in normal operation shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00			
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4.02.00	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. 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.			
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	(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 and the moisture content shall not be more than 10% for guarantee point condition. (vi) The contractor guarantees that the maximum purge rate to waste water treatment system shall not be more than 10 m3/hr for 500 MW unit and for combine 200 and 210 MW units shall not be more than as specified in the Table -1, averaged over a 24 hour period. Table-1 <table><tr><th>S.No</th><th>Project</th><th>Capacity (MW)</th><th>Concept</th><th>Waste water (m3/hr)</th></tr><tr><td rowspan="2">1.</td><td rowspan="2">FGUTPP St-I, II & III (2 X 210 + 2 X 210 + 1 X 210)</td><td rowspan="2">1050</td><td>Stage-I two units flue gas combined</td><td>8</td></tr><tr><td>Stage-II & III three units flue gas combined</td><td>12</td></tr><tr><td>2.</td><td>Farakka St-I (3 X 200)</td><td>600</td><td>Stage-I three units Flue gas combined</td><td>12</td></tr><tr><td>3.</td><td>Kahalgaon St-I (2 X 210)</td><td>420</td><td>Stage-I two units Flue gas combined</td><td>8</td></tr><tr><td>4.</td><td>Kahalgaon St-I (2 X 210)</td><td>420</td><td>Stage-I two units Flue gas combined</td><td>8</td></tr><tr><td rowspan="2">5.</td><td rowspan="2">Singrauli St-I (5 X 200)</td><td rowspan="2">1000</td><td>Stage-I two units Flue gas combined</td><td>8</td></tr><tr><td>Stage-I three units flue gas combined</td><td>12</td></tr></table> (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	S.No	Project	Capacity (MW)	Concept	Waste water (m3/hr)	1.	FGUTPP St-I, II & III (2 X 210 + 2 X 210 + 1 X 210)	1050	Stage-I two units flue gas combined	8	Stage-II & III three units flue gas combined	12	2.	Farakka St-I (3 X 200)	600	Stage-I three units Flue gas combined	12	3.	Kahalgaon St-I (2 X 210)	420	Stage-I two units Flue gas combined	8	4.	Kahalgaon St-I (2 X 210)	420	Stage-I two units Flue gas combined	8	5.	Singrauli St-I (5 X 200)	1000	Stage-I two units Flue gas combined	8	Stage-I three units flue gas combined	12	
S.No	Project	Capacity (MW)	Concept	Waste water (m3/hr)																																
1.	FGUTPP St-I, II & III (2 X 210 + 2 X 210 + 1 X 210)	1050	Stage-I two units flue gas combined	8																																
			Stage-II & III three units flue gas combined	12																																
2.	Farakka St-I (3 X 200)	600	Stage-I three units Flue gas combined	12																																
3.	Kahalgaon St-I (2 X 210)	420	Stage-I two units Flue gas combined	8																																
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5.	Singrauli St-I (5 X 200)	1000	Stage-I two units Flue gas combined	8																																
			Stage-I three units flue gas combined	12																																
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 18 OF 25																																

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	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 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.			
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	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: ii) Dew point of air at the outlet of air drying plants of air compressor. iv) Pressure drop across air drying plant . v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable) (xvi) Equipment Cooling Water System i) For pumps under ECW system -Vibration, noise and parallel operation without hunting & abnormal noise with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site. ii) Heat transfer coefficient determining the performance under 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) 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.			
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5.00.00	(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. $P_{an} = P_{un} + T_{Lu}$ P_{an} = Guaranteed 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 T_{Lu} = Proportional Losses of transformers for one Unit/Block T_L = Losses of all the transformers supplied by bidder based on works test Reports T_{Lu} shall be calculated as below: $T_{Lu} = (T_L / \text{Total MW capacity under the present contract}) \times (\text{capacity in MW for FGD (unit/block) under test})$ 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			
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	ix. Power consumption of Clarified water pumps (if provided) and Clarified booster water pumps (if provided) divided by the number of units in the project x. Power consumption of Process water pump(s) divided by the number of units in the project xi. Mist Eliminator Wash Water pump(s) xii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project xiii. Power consumption of total number of DM Cooling (working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system divided by the number of units (working) in the project xiv. Power consumption of total number of Auxiliary Cooling (working) water pump/Permeate water pump to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system divided by the number of units (working) in the project 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. (*)			
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	((*) 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) Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Singrauli STPP-I & II (5X200MW) & (2X500MW). xxv) Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Farakka STPP-I (3X200MW). xxvi) Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Farakka STPP-II (2X500MW). xxvi) Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Rihand STPP-I (2X500MW). xxvii) 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.. xxviii) 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.) xxix) 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 NOTE: 1. 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 basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power consumption shall be assigned to			
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5.00.00 (a)	each unit based on unit load for the purpose of calculating the unit auxiliary power consumption. - The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval. - 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. - Auxiliary power shall be measured without SCR (De-NOx) system. - Auxiliary power shall be measured at the switchgear of the drives. Power consumption for all the equipment's including auxiliaries with single stream operation lime stone handling, crushing and gypsum handling plant at its guaranteed flow path capacity in T/Hr Loading factor to be considered as 0.25 for lime stone handling and crushing plant equipment and 1 for Gypsum handling plant. Truck Tippler with Box feeder/Bulk material receiving unit/ /Surface Feeder. Paddle Feeder/Apron Feeder. Vibrating feeders and vibrating screens. Limestone Crushers. Belt Conveyors and Belt Feeders Bucket Elevators Reversible belt feeder/Plough feeder Travelling tripper Any other equipment not included under exclusion Note: Total o P Power consumption for all the equipment including auxiliaries with single stream operation at its guaranteed flow path capacity except: Lighting, Hoist, Lime Sampling unit, Sump Pumps, Elevators, DS,DE,SW System and Potable water system.			
6.00.00	METHOD OF COMPUTING TEST EFFICIENCY OF FGD The performance tests shall be carried out in accordance with ASME PTC 40 (2017) 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,			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	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 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 (b) 600 mg/Nm³ (6% O₂ dry) for units having capacity of 200 MW & 210 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.			
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SUB-SECTION-VII

MANDATORY SPARES

CLAUSE NO.	MANDATORY SPARES	
1.00.00 1.01.00	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: 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.	
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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. 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. 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.			
1.03.00	START-UP & COMMISSIONING SPARES 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.			
1.04.00	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:			
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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			
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CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
	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.			
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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.
		10. Booster fan impeller liner	1 sets
		11. Booster fan casing liner	1 set
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	1.02.00 <u>Gates in Flue Gas System</u> 1. Seals 1 set of each type (Set means complete 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 4. Absorber Ceramic Liner (including ceramic tiles and all the liner components) 2% of installed liner area 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		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES PAGE 6 OF 63

CLAUSE NO.	MANDATORY SPARES			
	5. Gear Box Assembly (If Applicable) 6. Agitator shaft assembly 7. Shaft seal 8. Complete Agitator assembly (B) AGITATORS for Mill Separator Tank, Limestone Slurry Preparation Tank, Secondary hydrocyclone feed, Waste water, Filtrate tank and any other tank provided with agitators) 1. Impeller Assembly 2. Bearing Assembly 3. Motor 4. Belt and Pulley (If applicable) 5. Gear Box Assembly (If Applicable) 6. Agitator shaft assembly 7. Complete Agitator assembly	1 no. of each type and size 1 no. of each type and size 1 no. of each type and size 1 no. of each type and size		
	1.07.00 <u>Slurry Pumps</u> (All slurry pumps including waste water, filtrate pump etc) 1. Impeller Assembly 2. Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing) 3. Casing Liners (where replaceable liners are provided) 4. Seals 5. Bearings	4 no. of each type and size 1 no. of each type and size 1 set* of each type & size 4 set of each type and size 1 no. of each type and size		
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CLAUSE NO.	MANDATORY SPARES		
	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 1.08.00 <u>Hydro-Cyclones</u> (Mill , Gypsum Primary Dewatering, 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.		
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CLAUSE NO.	MANDATORY SPARES		
	1.10.00 <u>Limestone Mills</u> 1. Mill Wear Parts (Liners) & Grinding element 1 sets (a) Mill liner- 1 set for complete replacement of one mill. (b) One set of Grinding element Note: One set of Grinding element above is defined as under : 1set =8000 X Ball consumption rate X Mill capacityX 10-6 /Tonnage of initial ball charge for one mill, rounded off to nearest higher whole number , where consumption rate is in gms/ton, Mill capacity in TPH 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 8.0 Mill circuit pump with motor - complete assembly 1 no.		
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CLAUSE NO.	MANDATORY SPARES	
	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 3. Seals 1 set 4. Motor 1 no. 1.15.00 <u>Vacuum Breaker Valves</u> 1. Valve Assembly 1 no. 2. Actuator 1 no. 1.16.00 <u>Sump Pumps</u> 1. Complete Impeller Assembly 1 no. of each type 2. Casing Liners 1 set* of each type 3. Bearing 1 set* 4. Motor 4 no. of each type 5. Pump discharge valve assembly 1 no. of each type 1.17.00 <u>Horizontal Centrifugal Pumps (All water pumps)</u> 1. Complete Impeller Assembly 1 no. of each type 2. Casing Liners (wherever applicable) 1 set* of each type	
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CLAUSE NO.	MANDATORY SPARES		
	3. Bearing	1 set*	
	4. Motor	1 no. of each type	
	5. Pump discharge Isolation valve assembly	1 no. each type, size, rating	
	Note:		
	1. Any change in size, material, design etc, which obviates one to one replacement of the part shall be considered a different type.		
	* Unless otherwise stated, a set shall mean complete replacement for one equipment.		
	1.18.00 <u>Goods Cum Passenger Elevator</u>		
	1. Friction block	2 nos.	
	2. Guide roller of each type	20% of total population or 3 nos. of type whichever is higher	
	3. Contactors of each type	2 nos.	
	4 Control Transformer	1 no. of each type	
	5. Time device	2 nos. of each type	
	6. Rectifiers	4 nos. of each type	
	7. Overcurrent relay	2 nos. of each type	
	8. Auxiliary relay	3 nos. of each type	
	9. Resistor	3 nos. of each type	
	10. Fuses of each rating	20% of the total population	
	11. Limit switches of each type	3 nos.	
	12. Push button	3 nos. of each type	
	13. Contact device (if applicable)	3 nos. of each type	
	14. Brake motor	2 nos. of each type	
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	15. Transmitters	2 nos. of each type	
	16. Switches of each type	3 nos.	
	17. Receiver	2 nos. of each type	
	18. Bearings of each type & size	2 nos.	
	19. Roller of each type	3 nos.	
	20. Worm gear spares		
	'O' rings	3 sets *	
	Sealing ring of each type	3 sets *	
	21. Spares for brake		
	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	
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1.19.00

EQUIPMENT COOLING WATER SYSTEM**A-1) Spares for horizontal pumps for ECW /Raw water system (for each type & size)**

Name of Items	Unit	QTY
Impeller with nuts & other accessories	Set	1
Wearing rings (Impeller & Casing ; as applicable)	Set	2
Shaft	Set	1
Shaft Sleeves	Set	2
Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
Pump bearings	Set	1
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)

Name of Items	Unit	QTY.
Bearings	Set	1
Rope guide	Set	1
Brake lining	Set	1
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)

Name of Items	Unit	QTY.
Gaskets	Lot	comprising 30% of total requirement
Fasteners	Lot	comprising 10% each type
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

CLAUSE NO.	MANDATORY SPARES		
1.20.00	DELETED		
1.21.00	DELETED		
1.22.00	<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.
	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
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CLAUSE NO.	MANDATORY SPARES	
	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 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. 5% or 1No. of each type and model whichever is more. 3.5 Relative Humidity Sensors 1 No. 3.6 Geyserstat 1 No. 3.7 Local Humidity/Temperature indicators 2 Nos. each 4.0 Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping /	
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CLAUSE NO.	MANDATORY SPARES	
1.23.00	Tubing and Air Supply Piping as Applicable) 4.1 Valves 10% or 1 No. of each type, class, size and model whichever is more. 4.2 2 way, 3way, 5way valve manifolds 10% or 1 No. of each type, class, size and model whichever is more. 4.3 Fittings 10% or 1 No. of each type, class, size and model whichever is more. (II) Ventilation System 5.0 Measuring Instruments 5.1 Pressure Gauge 1 No. (for centrifugal pumps of UAF units). 5.2 Level transmitter 1 No. 5.3 Pressure transmitter 1 No. (for UAF units) 6.0 Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable) 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	
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CLAUSE NO.	MANDATORY SPARES			
		ITEM DESCRIPTION	QUANTITY	
	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.	
	2.0	GATE VALVES		
	2.1	Complete Valve		
	2.1.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.	
	2.1.2	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.1.3	100 NB	10% or 1 No. of each type, class, size and model whichever is more.		
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CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
2.1.4	80 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.2	Reduction Gear Operator for Gate Valve		
2.2.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.3	Gate (Gate Valve)		
2.3.1	150 NB	5% or 1 No. of each type, class, size and model whichever is more.	
2.3.2	250 NB	5% or 1 No. of each type, class, size and model whichever is more.	
2.3.3	100 NB	5% or 1 No. of each type, class, size and model whichever is more.	
2.3.4	80 NB	5% or 1 No. of each type, class, size and model whichever is more.	
2.4	Stem (all types), Seat ring (all types), Gaskets & Yoke Bush/Wedge Nut for Gate Valve		
2.4.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4.2	150 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4.3	100 NB	10% or 1 No. of each type, class, size and model whichever is more.	
2.4.4	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		
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CLAUSE NO.	MANDATORY SPARES		
	ITEM DESCRIPTION	QUANTITY	
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.	
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		
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	ITEM DESCRIPTION	QUANTITY	
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.	
7.3.2	Pre fabricated cable connector	1 no. of each type and model	
7.3.3	Other cables (including core cable, short term fire proof cable, fibre optic cables etc)	5% of each type, pair/ core and size of actual installed quantity.	
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	ITEM DESCRIPTION	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	
7.5	PLC CONTROL SYSTEM	Quantity	
7.5.1	Power Supply Unit	1 No. of each type and model,	
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ITEM DESCRIPTION QUANTITY

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

CLAUSE NO.	MANDATORY SPARES 		
1.24.00	ITEM DESCRIPTION QUANTITY 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>		
		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
	1.5	HP stage Gear and Pinion	1 Set
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CLAUSE NO.	MANDATORY SPARES		
		ITEM DESCRIPTION	QUANTITY
	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 with actuators	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	
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CLAUSE NO.	MANDATORY SPARES		
	4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 No. of each type and model whichever is more	
	5 Dew Point meters	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)	10% or 1 no. whichever is more	
	2 Power supply module (if applicable)	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.		
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1.25.00	<u>LIMESTONE & GYPSUM HANDLING</u>					
S.N.		If Applicable (Y/N)	ITEM	QTY	Unit	
1	Mechanical					
A)	Paddle Feeder					
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)			
	i)		Complete assembly	1	set of each type	
	ii		Bearings	1	set of each type	
	iii)		Oil Seals	2	nos. of each size	
	iv)		Input shaft with pinion	2	sets of each type	
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	
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CLAUSE NO.	MANDATORY SPARES			
5	Carriage wheel assembly			
	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
6	vi)	Tension roller of paddle feeder trolley	1	set
	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
7	iii)	Rubber bush / spider / inserts	8	sets of each size
	i)	Brakes (if any)	2	sets of each type & size
8	ii)	Brake shoe	4	sets of each type & size
	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
	xi)	Eddy current/magnetic coupling	1	set of each type & rating

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B)	xii)	Spare Festoon hanger cum roller assembly(below CRD)	10	nos.	
	xiii)	Spare energy chain links	5%	of population	
	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	
C)	12	Any other type of idlers	10%	of population of each type	
CONVEYOR GEAR BOXES					
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D) a) 					

CLAUSE NO.	MANDATORY SPARES				
d) <					

CLAUSE NO.	MANDATORY SPARES				
G)	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	
	IN-LINE MAGNETIC SEPARATORS				
	i)	Cleated conveyor belt	1	set	
	ii)	Motor, gear box drive assy. complete	1	set	
	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	
	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.	
	H)	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	
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CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
I)	xvii)	Coupling with grid for primary sampler	2 sets	
	xviii)	Screw conveyor gear box assembly	1 set	
		LIME CRUSHER		
	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.	
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CLAUSE NO.	MANDATORY SPARES				
J)	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	
	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	
K)	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	
	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	
	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	
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CLAUSE NO.	MANDATORY SPARES			
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
M)	v)	Pressure nut	12	nos. of each type & size
	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
N)	iv)	Actuator (complete with motor, gear box, limit switches etc.)	1	nos of each type & rating
	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
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 &
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 35 OF 63

CLAUSE NO.		MANDATORY SPARES		एनटीपीसी NTPC		
P)	f)	Bushings	2	size	sets of each type & size	
	g)	Coupling bolts & nuts (with bushes) 2 sets	1	size	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.	
	VENTILATION SYSTEM					
	i)	V-Belt	1		set of each type	
	ii)	Pre-filter element of pressurizing fans	2		sets of each type	
	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
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CLAUSE NO.	MANDATORY SPARES				एनटीपीसी NTPC
R)	iii)	Bearings for reducer	2	sets	
	iv)	Drive axle with wheels, plumber 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 wiith sprockets	1	set of each type & size	
	ix)	Festoon Roller assembly for flexible cable	4	Nos	
	x)	Pulleys and plumber block bearings	1	no of each type	
	xi)	Plummer block with bearing for cable reel drums	1	set of each type	
	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.	
		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.		
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CLAUSE NO.		MANDATORY SPARES		एनटीपीसी NTPC		
S)	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		
		DUST EXTRACTION SYSTEM				
	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 slury 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			
T)	10	Spray nozzle	10	nos of each type		
	11	Solenoid valve with coil	2	nos of each type		
		BUCKET ELEVATOR				
	1	Buckets	10	% of total population		
	2	Belt for bucket elevator	10	% of total population		
U)	3	Linkages	20	% of total population		
		Surface Feeder/ Box Feeder/ Truck Unloading System			Drawing/ Catalog required for identifying parts	
	i)	Head shaft	one	no		
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CLAUSE NO.	MANDATORY SPARES				
	ii)	Tail shaft	one	no	
			One	no	
			length		
	iii)	Chain	h		
	iv)	Flight Bars	one	Set	
	v)	Keeper Plates	One	Set	
	vi	Side Liners	one	set	
	vii	Gearbox	one	No each type	
	viii	Coupling	one	No each type	
	viii	Bearings	one	No each type	
	ix	Oil seals	one	No each type	
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 quantity so calculated happens to be a fraction, the same shall be rounded off to next higher whole number. 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					
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CLAUSE NO.	MANDATORY SPARES	
1.26.00	<u>CONTROL AND INSTRUMENTATION</u> (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. 10% or 1 no. of each type and model, whichever is more. (ii) Density meter 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. 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.	
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CLAUSE NO.	MANDATORY SPARES			
	(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 SO ₂ , NO _x , CO ₂ , 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)	O ₂ 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	
	(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			
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CLAUSE NO.	MANDATORY SPARES			
	(i)	Analysers for SO2, 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	NOT USED		
	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.	
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC	
	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.	
	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	
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CLAUSE NO.	MANDATORY SPARES		एन टी पी सी NTPC
	(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 complete.	2 nos. of each type and model	
	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	1 no of each type and model	
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	complete. 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 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 20% or 2 Nos. of each type, model and rating whichever is more subject to maximum of 40 Nos of each type.		
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CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	cables 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 % 1.8 Panel meters 10% or 2 nos. whichever is more. 1.9 Limit 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-hydraulic actuator assembly 10% or 1 no. of each type, model and 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		
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CLAUSE NO.	MANDATORY SPARES			
	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 4 Electronic Torque sensor 5% of each type & model			
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CLAUSE NO.	MANDATORY SPARES			एनटीपीसी NTPC
1.27.00	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	
	<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.	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 48 OF 63

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC	
	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 & 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	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 49 OF 63

CLAUSE NO.	MANDATORY SPARES		
	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
	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
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES
			PAGE 50 OF 63

CLAUSE NO.	MANDATORY SPARES			
	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	5 nos	
		b) 20A rotary switch	5 nos	
	4.	Junction Boxes: Type F-2 Terminal Strips	25 nos	
	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.	
	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			
	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9			
SUB-SECTION-VII MANDATORY SPARES				
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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
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.

CLAUSE NO.	MANDATORY SPARES 		
	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.
	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 &
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES PAGE 53 OF 63

CLAUSE NO.	MANDATORY SPARES			
			rating	
	2.6	Control Transformers	1 no of each type & rating	
	i. 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			
	<u>I. List of Mandatory spares for Dry Type Transformers</u>			
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.				
<u>II. Mandatory spares for oil filled outdoor transformers</u>				
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		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 54 OF 63

CLAUSE NO.	MANDATORY SPARES																																																																																		
	<table> <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. Mandatory spares for FGD Tie transformers <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> <tr><td>3.</td><td>MV bushing with metal parts and gaskets(nos.)</td><td>-</td></tr> <tr><td>4.</td><td>LV bushing with metal parts and gaskets(nos.)</td><td>3</td></tr> <tr><td>5.</td><td>LV Neutral bushing with metal parts and gaskets(no.)</td><td>1</td></tr> <tr><td>6.</td><td>WTI with contacts(no.)</td><td>1</td></tr> <tr><td>7.</td><td>OTI with contacts(no.)</td><td>1</td></tr> <tr><td>8.</td><td>Pressure relief device(no.)</td><td>1</td></tr> <tr><td>9.</td><td>MOG(no.)</td><td>1</td></tr> <tr><td>10.</td><td>Buchholz relay complete(no.)</td><td>1</td></tr> <tr><td>11.</td><td>Set of gaskets</td><td>1 Set</td></tr> <tr><td>12.</td><td>Set of valves</td><td>1 Set</td></tr> <tr><td>13.</td><td>Cooler fan with motor (nos.)</td><td>2</td></tr> <tr><td>14.</td><td>Oil Pump with motor(nos.)</td><td>-</td></tr> <tr><td>15.</td><td>Oil flow meter(nos.)</td><td>-</td></tr> <tr><td>16.</td><td>Set of On load/Off Circuit Tap changer contacts</td><td>1 (OLTC)</td></tr> <tr><td>17.</td><td>Air cell for conservator(no.)</td><td>1</td></tr> <tr><td>18.</td><td>Neutral Grounding Resistor w/o supporting structure (11 kV, 11.07 ohms, 600A for 10sec.)</td><td>2 Nos.</td></tr> <tr><td>19.</td><td>Neutral Grounding Resistor w/o supporting structure (3.3 kV, 3.32 ohms, 600A for 10sec.)</td><td>2 Nos.</td></tr> </table>	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	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.	
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LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES PAGE 55 OF 63																																																																																	

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC				
	* (with stand for vertical storage) Note: 1 set consists of quantities required for 1 complete transformer. 1.07.00 VFD 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 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 1 set <tr><td>LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9</td><td>SUB-SECTION-VII MANDATORY SPARES</td><td>PAGE 56 OF 63</td></tr>			LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 56 OF 63
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES	PAGE 56 OF 63				

CLAUSE NO.	MANDATORY SPARES		एनटीपीसी NTPC
	(thyristor, IGBT etc.)		
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	
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	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES
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CLAUSE NO.	MANDATORY SPARES		
	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
	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.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES
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CLAUSE NO.	MANDATORY SPARES		
	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.
	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.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES
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CLAUSE NO.	MANDATORY SPARES	एनटीपीसी NTPC																																																															
	1.09.00 220KV SWITCHYARD (IF APPLICABLE) <table> <tr> <th>S.NO.</th><th>ITEM DESCRIPTION</th><th>QTY (of offered type)</th></tr> <tr> <td colspan="3">I. CIRCUIT BREAKERS</td></tr> <tr> <td>1</td><td>One Complete breaker, 3 Poles along with drive unit, marshalling box & terminal connectors</td><td>1 no.</td></tr> <tr> <td>2</td><td>Tripping and closing coil (one set consisting of one no. each of all types)</td><td>3 sets</td></tr> <tr> <td>3</td><td>Spring charging motors (if applicable)</td><td>1 no.</td></tr> <tr> <td>4</td><td>SF6 Gas filling Valve (DILO)</td><td>1 no.</td></tr> <tr> <td>5</td><td>SF6 gas</td><td>3 Cylinders</td></tr> <tr> <td colspan="3">II. ISOLATORS</td></tr> <tr> <td>1</td><td>One complete pole of HCB isolator with 2 E/S along with operating mechanisms, etc.(without Structure)</td><td>1no</td></tr> <tr> <td colspan="3">III CURRENT TRANSFORMER complete in all respects including terminal connectors.</td></tr> <tr> <td></td><td></td><td>1 no.</td></tr> <tr> <td colspan="3">V SURGE ARRESTER complete in all respects including terminal connector and with surge counter and lead.</td></tr> <tr> <td></td><td></td><td>1 no.</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> 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> </table>	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 terminal connector and with surge counter and lead.					1 no.	VI	String insulator & hardware, clamp connectors, spacers and Corona bells	10% of total quantity of each type and rating	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	
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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 terminal connector and with surge counter and lead.																																																																	
		1 no.																																																															
VI	String insulator & hardware, clamp connectors, spacers and Corona bells	10% of total quantity of each type and rating																																																															
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																																																															
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES PAGE 60 OF 63																																																															

CLAUSE NO.		MANDATORY SPARES		एनटीपीसी NTPC	
		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.		
		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.		
1.28.00		MANDATORY SPARES FOR CHIMNEY ELEVATOR			
		(Qty. indicated are for one (1) No. Chimney Elevator)			
A.		BRAKE ASSEMBLY		Qty.	
		1.	Brake Assembly complete	1 No.	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9		SUB-SECTION-VII MANDATORY SPARES	
				PAGE 61 OF 63	

CLAUSE NO.	MANDATORY SPARES	एनटीपीसी NTPC
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 no. whichever is higher 9. Switch 3 Nos.	
F.	SLIDING DOOR 10. Rollers (if applicable) 4 Nos. each type	
G.	MACHINERY 11. Guide roller 2 Nos. 12. Pinion 2 Nos. 13. Rubber inserts (if applicable) 12 Nos. 14. Groove ring (if applicable) 6 Nos. 15. Brake motor 1 No.	
H.	CABLE TROLLEY BEARING (if applicable) 16. Bearing 3 Nos. of each type	
I.	ELECTRICAL EQUIPMENTS 17. Contactors 1 No. of each type	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9 SUB-SECTION-VII MANDATORY SPARES PAGE 62 OF 63

CLAUSE NO.	MANDATORY SPARES	
	18. Auxiliary transformer 1 No. 19. Relays 1 No. of each type & rating 20. Switch 2 Nos. each type 21. Rectifier 3 Nos. 22. Limit switch 3 Nos. each type 23. Transmitter (if applicable) 1 No. if applicable 24. Receiver (if applicable) 1 No. if applicable 25. Battery charger 1 No. 26. Push Buttons 3 Nos. of each type 27. Timers 2 Nos. of each type & rating 28. Main drive motor with control system 1 Set	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-VII MANDATORY SPARES PAGE 63 OF 63

NTPC Limited

(A Government of India Enterprise)



LOT-4 PROJECTS

PART - B

SUB-SECTION-I-M (MECHANICAL SYSTEM)

SECTION – VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(4)-9

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-I-M (MECHANICAL SYSTEM)

SUB-SECTION-I-M1

FLUE GAS DESULPHURISATION SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
1.00.00	FLUE GAS DESULPHURIZATION (FGD) SYSTEM															
	GENERAL															
	The design/specifications/sizing of various plants/systems/equipment offered for Flue Gas Desulphurisation (FGD) System shall comply with the requirements detailed hereinafter:															
1.01.00	System Description															
	The Flue Gas Desulphurisation (FGD) System shall be based on Wet Limestone Forced Oxidation process. The FGD system shall be installed downstream of the Induced Draft (ID) fans (Employer's scope).The flue gas is drawn from air preheater outlets of the balanced draft, pulverised coal fired Steam Generator and guided through adequately sized duct work into the specified number of independent gas streams of each Electrostatic Precipitators. The flue gas after the Electrostatic Precipitators is led to the suction of the ID fans. The flue gas temperature may approach the economiser outlet temperature of about 300°C in case the regenerative airpreheaters fails to operate. The Contractor shall take this aspect into account while designing the Flue Gas Desulphurisation (FGD) System.															
1.02.00	Service Conditions															
	The Steam Generators provided are designed to burn pulverised coal having properties as indicated in Sub-section-II-A (Project Information), Part-A, Section-VI. Also HFO/HPS/LSHS and LDO shall be used during startup and at low loads for warm up and flame stabilization as specified in respective Project Information Chapter. The design of Steam Generator does not call for any oil support for flame stabilization beyond 40 % BMCR load when firing any coal. Further, the frequency and duration for startup and low loads operation may be quite long during the first year of unit commissioning and operation. The Steam Generator has been designed for cyclic/two shift operation. Expected numbers of Steam Generator start-ups during 25 years of design life are as follows:															
	<table><tr><td></td><td>Type of Starts</td><td>Number of Starts</td></tr><tr><td>a.</td><td>Hot start (after 8 hours of unit shut down)</td><td>4000</td></tr><tr><td>b.</td><td>Warm start (after 36 hours of unit shut down)</td><td>1000</td></tr><tr><td>c.</td><td>Cold start (after 72 hours of unit shut down)</td><td>150</td></tr></table>					Type of Starts	Number of Starts	a.	Hot start (after 8 hours of unit shut down)	4000	b.	Warm start (after 36 hours of unit shut down)	1000	c.	Cold start (after 72 hours of unit shut down)	150
	Type of Starts	Number of Starts														
a.	Hot start (after 8 hours of unit shut down)	4000														
b.	Warm start (after 36 hours of unit shut down)	1000														
c.	Cold start (after 72 hours of unit shut down)	150														
	The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired and the expected numbers of Steam Generator start-ups while designing the FGD system.															
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 1 OF 51												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.03.00	Design Criteria			
1.03.01	The Flue Gas Desulphurisation (FGD) System shall be designed to meet all the conditions specified above. Representative coal and ash analysis for the expected coal and oil are given in Sub-section-II-A (Project Information), Part-A, Section-VI for each project. The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated under ‘Guarantee Point’ and ‘Design Point’ conditions indicated in Sub-Section-V, Part-A, Section-VI of the Technical Specification for the respective projects. The values indicated for FGD sizing shall be considered as minimum design criteria. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements. The Contractor shall also furnish along with his offer the detailed calculations and data along with his Bid to establish as to how the Bidder will meet the efficiency requirements both at design and guarantee point as specified in FGD sizing criteria.			
1.03.02	The FGD system shall be installed downstream of the ID fans and shall be based on wet Limestone Forced Oxidation Process. The FGD system shall be designed to achieve the required SO₂ capture without the use of oxalic acid or any other additives. The FGD System shall be designed so as to be in operation whenever the Steam Generator is in operation. However, provision shall be made by the Contractor for facilitating operation of unit with emergency FGD bypass. This shall also facilitate the online maintenance of absorber system and associated equipment’s. The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose, Motorized Guillotine type gates shall be provided by the Contractor at (i) hot gas inlet to Booster Fans, (ii) Outlet of Booster Fans. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct (flow bypass into existing chimney) by the Contractor. Further, in case of Kahalgaon-I & II (4 X 210 MW) One quick acting biplane bypass damper shall be provided at the bypass line of the absorber (Absorber bypass line shall be designed for 40% flue gas flow entering at the inlet of FGD system) for controlling the flue gas flow. The same shall also be taken into account while designing the control & logics for the FGD System.			
1.03.03	The wet absorber system shall be designed to maintain the required SO₂ removal.			
1.03.04	In order to be compatible to all possible modes of operation, the design of the FGD plant shall enable short start-up times, compatible with load changes in the Steam Generator and shall ensure reliable mode of continuous operation.			
1.03.05	The flue gas desulphurization plant (FGD) shall be designed to be operated with limestone as specified in Sub-Section-V, Part-A, Section-VI of the Technical Specification.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 2 OF 51

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.03.06	The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator. Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of SO₂ emission of less than: (a) 200 mg/Nm³ (6% O₂ dry) for units having capacity of 500 MW (b) 600 mg/Nm³ (6% O₂ dry) for units having capacity of 200 / 210 MW			
1.03.07	In case of failure of the SG and ancillary equipment, the FGD plant shall be brought automatically to the off-load operation without restriction by the current load case by suitable measures.			
1.03.08	In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system of 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. Bidder shall furnish a list of all such Auxiliaries in their bid proposal.			
1.03.09	In case of shutdown and outage periods, draining and flushing of limestone slurry and gypsum slurry pipe work, tanks and all other items being in contact with limestone slurry or gypsum slurry shall be possible without restriction and without necessity of extensive or unusual preparation and activity. Draining and flushing which are required even during short time outages or an emergency shutdown shall be started automatically and by remote control from the Control Room.			
1.03.10	All items or equipment which are subject to wear, abrasion or failure (e.g. nozzles, pumps, pipe work, etc.) shall be designed and installed for easy replacement, repair and maintenance.			
1.03.11	The design and the construction shall be performed so as to avoid stress corrosion cracking, galvanic or other types of corrosion. Especially when using two different alloys, appropriate measures shall be taken to avoid corrosion. This is subject to approval by the Employer.			
1.03.12	All items of equipment including flue gas ducts, expansion joints, etc. shall be designed considering thermal and mechanical strength as a function of the maximum temperature which might occur in case of a failure of any upstream equipment.			
1.03.13	Waste water which might be generated during flushing and cleaning procedures of the equipment (e.g. lime slurry bins, pipes, trucks, etc.) shall be collected in sump and shall possibly be reused in the wet absorber.			
1.03.14	In case distance from Limestone Grinding system/ Gypsum Dewatering and Absorber is more than 500M, Bidder shall provide the following :- Flushing system at intermittent locations for the lime stone slurry pipeline which shall contain tank and pumps. Intermittent location distance of flushing system shall be based on their proven practice.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 3 OF 51

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.00	Justification of Proposed Design			
1.04.01	All the design procedures, systems, and components proposed shall have already been adequately developed and have demonstrated good reliability under similar or more arduous conditions elsewhere.			
1.04.02	The Bidder shall submit with the offer, comprehensive information on how the L/G ratio, mass balance, spray nozzle cone angle, spray nozzle arrangement, limestone consumption etc. of the proposed design has been arrived at. The Contractor shall also submit alongwith the offer, a detailed write up on the proposed design features with recent design modifications, if any, and their specific advantages over the previous designs.			
1.05.00	Statutory Approval			
	The engineering, design, supply and installation of FGD system and the associated auxiliaries shall comply with the applicable safety code and regulation of the locality where the system is being installed.			
1.06.00	Location & Layout Requirements			
1.06.01	The Contractor shall offer the best design to accommodate the Flue Gas Desulphurisation (FGD) System and Lime stone & Gypsum handling & storage system within the confines of the space available. The location of FGD System and associated facilities shall be decided by the Bidder after visiting the Project site.			
1.07.00	Capital Overhaul of FGD System			
	Employer envisages to carryout the capital overhaul of units once in three (3) years. The design and materials for various equipments/auxiliaries etc. shall be selected by the Contractor keeping in view the above requirement of the Employer, such that no major repairs/replacements, requiring shutdown of the unit, are needed in between the capital overhauls.			
1.08.00	Maintenance			
1.08.01	The Contractor shall provide adequate handling facilities & approach as for carrying out on-line and off-line maintenance of the FGD system and its auxiliaries. In order to carry out on-line maintenance, it shall be possible to readily disassemble, repair and reassemble the equipment supplied in the shortest period.			
1.09.00	Noise level			
	The equivalent weighted average of sound level measured at a distance of 1.5 m above floor level in each elevation and one meter horizontally from the base of any equipments furnished and installed under these specifications, expressed in decibel to a reference of 0.0002 microbar, shall not exceed 85 dB(A). However for Ball Mill and Crusher, the noise levels as per following shall also be acceptable: a) Ball Mill: 90 dBA			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 4 OF 51

CLAUSE NO.	TECHNICAL REQUIREMENTS																		
2.00.00	b) Crusher: 90 dBA																		
	EQUIPMENTS AND SYSTEMS SPECIFICATIONS																		
	Specified hereafter are the minimum acceptable functional requirements of the Employer, and all components, equipments and systems for the Flue Gas Desulphurisation System shall be designed to cater to these requirements. Compliance to various stipulations of the Technical Specifications, functional requirements of Employer and utilization of various parameters and their values in the specification by the Contractor shall in no way relieve the Contractor of his responsibilities to meet all guarantee requirements or of providing completely safe and reliable operating equipment/systems. The complete FGD system and the associated auxiliaries shall be designed by the standard industrial practices. The FGD system shall be designed to achieve the required SO₂ capture without the use of oxalic acid or any other additives. Only field proven materials for similar application shall be used for the system. The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines. In the execution of the welds contractor must ensure that welding material has same corrosion resistance as the actual plate surface. Alloy to carbon steel welds must either be hidden behind a covering strip of alloy material, or be executed by a special welding procedure ensuring the same quality at the weld surface as the alloy lining. All welding which shall be in the contact with process fluids shall be executed under the supervision of the designer/manufacturer.																		
3.00.00	FLUE GAS SYSTEM																		
3.01.00	The entire flue gas system, flue gas ducts inlet to absorber and bypass duct etc. shall be designed to meet the following conditions: <table><tr><td>1.</td><td>Design internal pressure at 67% yield strength (mm wc)</td><td>+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher</td></tr><tr><td>2.</td><td>Design Inlet Gas Temperature (deg.C)</td><td>150</td></tr><tr><td>3.</td><td>Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C)</td><td>300</td></tr><tr><td>4.</td><td>Inlet Dust Burden in Gas (mg/Nm3)</td><td>200</td></tr><tr><td>5.</td><td>Maximum flue gas velocity through the Absorber (M/sec)</td><td>Not more than 4 m/s at Design Point Conditions</td></tr></table>				1.	Design internal pressure at 67% yield strength (mm wc)	+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher	2.	Design Inlet Gas Temperature (deg.C)	150	3.	Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C)	300	4.	Inlet Dust Burden in Gas (mg/Nm3)	200	5.	Maximum flue gas velocity through the Absorber (M/sec)	Not more than 4 m/s at Design Point Conditions
1.	Design internal pressure at 67% yield strength (mm wc)	+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher																	
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5.	Maximum flue gas velocity through the Absorber (M/sec)	Not more than 4 m/s at Design Point Conditions																	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 5 OF 51															

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	6.	Recirculation Slurry pH	Not less than 5.5 under all operating conditions	
3.02.00	Design			
3.02.01	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 16.00.00 this subsection.			
3.02.02	All ducts with operating temperature above 60 ⁰ C shall be insulated in accordance with cl. No. 17.00.00 of this sub section.			
3.02.03	The duct layout shall ensure that there is no accumulation of acid mist on the duct floor.			
3.02.04	The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct from Absorber outlet to the new wet flue chimney shall be made of Carbon steel of minimum 7mm thickness clad with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / Titanium Gr-II. In case Kahalgaon St-(4 x 210 MW) projects Absorber bypass duct has been envisaged which shall be designed considering a flow of 40% flue gas entering at the inlet of the FGD system. Bypass duct from the interconnection of the duct which is going to the new wet flue chimney shall be made of Carbon steel of minimum 7mm thickness clad with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / Titanium Gr-II up to a length of 1-2 meter. Quick acting biplane bypass damper in the absorber bypass line shall also be made of Carbon steel of minimum 7mm thickness clad with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / Titanium Gr-II. Bidder to ensure proper mixing of the treated and untreated flue gas at the duct interconnection and in the downstream duct going to the new chimney.			
3.02.05	In addition to the base offer as described above, the bidder may also submit an alternate offer for a different material / lining of duct from Absorber outlet to stack, if the bidder has previous experience of the same. The bidder should have supplied a similar design of duct in previous installations for similar application. Bidder shall indicate the applicable price implication for such an alternate offer in the relevant Bid Proposal sheet. The Bidder shall also furnish details of the previous installations of such system and bring out all the technical features of the system proposed. Bidder to note that application of lining material in the ducts shall be carried out under the supervision of designer/manufacturer. Bidder to note that application of lining material in the duct shall be carried out under supervision of Designer/Manufacturer.			
3.02.06	Wherever required, expansion joints of proven design shall be provided in the ducts to take care of differential expansion in the system. The material chosen for expansion joints shall suitable for the duty conditions and the corrosive atmosphere of the FGD system and shall be field proven for similar applications. The expansion joints shall be guaranteed for faultless material and workmanship, for a minimum guaranteed life of not less than 20000 hrs. of operation. During Guarantee period			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 6 OF 51

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	any defects noticed in the expansion-joints due to faulty material and workmanship shall be rectified by the Contractor free of cost.			
3.02.07	The chimney shall be designed to meet the criteria as specified in clause 4.00.00 of Salient Design Data Subsection-V Part A of the technical specification.			
3.03.00	Gates & Dampers			
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 dampers shall be provided by the Contractor before the suction and discharge of each Booster fan.			
3.03.02	All gates/dampers shall be designed to withstand the operating flue gas temperature without distortion.			
3.03.03	There shall not be any backlash, play, etc. with linkage mechanism, actuator and final control element.			
3.03.04	Thermal expansion of ducting shall not produce stress in louvers, linkage arrangement etc.			
3.03.05	Outlet dampers of seal air fans shall be pneumatically operated, suitable for remote manual operation.			
3.03.06	All pneumatically operated interlocked dampers actuators shall be provided with solenoid valves.			
3.03.07	A quick acting biplane damper shall be provided by the Contractor in the bypass duct (Flue gas duct connecting the existing chimney) for quick opening to allow bypass to come into operation in case of emergency to avoid the unit trip. The damper shall be capable of quick opening during emergency conditions within a time of 10-20 secs. Bidder should indicate the required opening time for bypass damper for emergency operating condition.			
3.03.08	All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at Clause No. 3.03.01 above shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.95% along the duct as well as from the duct to atmosphere or from atmosphere to the duct, depending on the pressure in both the damper open and damper closed condition without the use of seal air fans of the damper and 100% leak tight with seal air fans under operation. The motor operated Guillotine gates shall also be provided with a 2X100% complete seal air system. The bypass dampers shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.5% and 100% leak tight with seal air fans under operation. The gas tightness shall be demonstrated at shop for minimum one type of damper of each type and size.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 7 OF 51

CLAUSE NO.	TECHNICAL REQUIREMENTS														
3.03.09	The dampers shall be pneumatically operated and controlled from the control room. Provision shall be made for giving signal automatic bypass controls of the absorber in case of failure of the absorber spray system. The dampers shall have provision for manual operation, through a hand wheel. The force required for manual operation of the gate shall not exceed 35 kg (max.) at the rim of the hand wheel.														
3.03.10	The isolating gates shall be provided with locking devices to permit locking in fully closed position.														
3.03.11	Pressurization Fans: a) All gates shall be provided with 2x100% pressurization fans to achieve 100% sealing efficiency. b) The location and scheme for pressurization system shall be subject to Employer's approval.														
3.03.12	All gates shall be designed to withstand the operating air and flue gas temperature without distortion.														
3.03.13	All guillotine gates shall be located in horizontal duct to avoid fly ash build up when in closed position and shall be of top entry type.														
4.00.00	BOOSTER FAN:														
4.01.00	The Booster Fans shall be located downstream of the ID Fans (Induced Draft Fans) in the inlet duct to Absorber shall be capable of handling the pressure drop in the FGD system & ducting and wet stack of 150 m height also considering the exit loss from wet stack over the entire load range with any one or both Booster fans in operation in conjunction with one or both ID fan in operation while firing the specified range of fuels.														
4.01.01	Booster Fans shall be sized such that they satisfy the criteria stipulated below. <table><thead><tr><th>S.N.</th><th>Description</th><th>Booster Fan</th></tr></thead><tbody><tr><td>1</td><td>Type of fans</td><td>Constant speed, axial type.</td></tr><tr><td>2</td><td>No. of fans per unit</td><td>Two</td></tr><tr><td>3</td><td>Fan sizing criteria with all the following conditions occurring together :</td><td>Booster Fan to be sized for one (1) Booster Fan stream in operation taking into account following factors occurring together:</td></tr></tbody></table>			S.N.	Description	Booster Fan	1	Type of fans	Constant speed, axial type.	2	No. of fans per unit	Two	3	Fan sizing criteria with all the following conditions occurring together :	Booster Fan to be sized for one (1) Booster Fan stream in operation taking into account following factors occurring together:
S.N.	Description	Booster Fan													
1	Type of fans	Constant speed, axial type.													
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LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9	PART-B SUB-SECTION-I-M1 (FGD) PAGE 8 OF 51												

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
4.01.02	(i)	Flue Gas Flow through fan	630 m ³ /sec for all 500 MW unit each	
			520 m ³ /sec where 2 x 210 / 200 MW units has to be combined	
			780 m ³ /sec where 3 x 210 / 200 MW units has to be combined	
	(ii)	Power supply frequency	47.5 Hz	
	(iii)	Pressure at Terminal Point before Booster Fan suction	0 mmWc	
	(iv)	Gas temperature (degree Celsius)	150	
		The fans shall also fulfill following sizing criteria in addition to those mentioned at clause 4.01.01 above	Each fan to be sized with following conditions occurring together.	
	(i)	No. of fans in operation	2	
	(ii)	Flue gas flow through each fan	506 m ³ /sec for all 500 MW unit each	
			418 m ³ /sec where 2 x 210 / 200 MW units has to be combined	
		627 m ³ /sec where 3 x 210 / 200 MW units has to be combined		
	(iii)	Margin over flow	20%	
	(iv)	Margin over pressure requirement	Bidder shall consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%. For bubbling type Absorber, Bidder shall consider choking/blockage of 10%	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
		sparger tubes while calculating the head requirements of fan.	
	(v)	Power supply frequency	50 Hz
	(vi)	Pressure at Booster Fan suction	0 mmWc
	(viii)	Gas temperature (degree Celsius)	150
	(viii)	Flue gas control	Blade pitch control
	Note to 4.01.01 & 4.01.02: Booster fan shall have a minimum stall margin of 10% over the Design duty points.		
4.02.01	Both fans shall operate with highest possible efficiency which shall be nearly equal at the Guarantee point flow and test block points.		
4.03.00	Fan components along with servo/blade pitch control mechanism shall be designed to withstand and continuously operate with the maximum air or flue gas temperature that these fans will be required to handle. Fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration. Such temperature excursion will not inhibit the safe and smooth operation of fans or cause any damage or increased maintenance.		
4.04.00	The construction of Booster fans shall also comply with following requirements		
	DESCRIPTION	Booster Fans	
	Type of fan blades	stream lined, aerofoil shaped section	
	Blade material	Nodular Cast Iron or High Wear Resistant Steel with or without Hard coating as per the proven practice of the fan manufacturer	
	Fan rotational speed	745 rpm (max.)	
	Air/Flue gas flow	blade pitch control	
	Fan critical speed	not less than 125% of fan maximum operating speed	
	Fan component design*	to withstand torsional stresses three (3) times the normal full load motor torque at all speeds	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.00	DESCRIPTION	Booster Fans		
	Fan casing material thickness Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.) Alternatively, 22 mm thickness casing of mild steel is also acceptable. Fan Housing design for shut off head of fan *Note : (a) Contractor shall submit detailed calculations, for Employer's approval, to confirm compliance with above requirements for all fan components, specifically for fan shafts, impeller hubs and impeller as a whole. Areas of high stress concentration and residual stresses, like welded attachments shall be avoided on the fan rotor/shafts. Combined static, dynamic as well as residual stresses shall be demonstrated to be within allowable limits. These fan components shall last the life of the plant with such combined stresses present in them. (b) Although employer envisages to install highly efficient electrostatic precipitator to control particulate emission, however. Bidder shall select the Booster fan components such as blades, hubs, casing etc. to encounter the high dust burden of the order of 250 mg/Nm³. The minimum wear life of Booster fan components shall not be less than 25000 hours of operation from the date of commissioning.			
	Fan Bearings			
	(a) Bearing shall be provided with oil bath to prevent damage in case of complete loss of plant auxiliary power when the fans must coast down without power. (b) Size oil reservoir in bearings housing for maintaining lubrication for extended periods in case of oil circulation system is out of service. (c) Cooling air circulation to be provided across main bearing (d) Adequate numbers of duplex Pt-RTD (100 ohm at 0 degree Celsius) and temperature indicator shall be provided for each bearing. Local as well as remote monitoring features shall be provided. (e) For mounting of vibration pads/pickups, flat surfaces shall be provided both in X and Y directions, by the Contractor on the bearing housing.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC										
4.06.00	Fan balancing (a) The fans shall be statically and dynamically balanced before shipment. (b) Balancing of each fan shall be checked and adjusted at site, if necessary. (c) Natural frequency of all fan components shall be established by vibration testing to ensure that no part of the wheel is adversely excited by any force generated at operating speeds. (d) The fan blade shall be subjected to natural frequency test. The other components of fan wheels need not be subjected to natural frequency test if supplier can prove that these component are very rigid and have very high natural frequency compared to the operating frequency of respective fans giving justification.										
4.07.00	Booster fans shall meet following operational requirements. <table> <tr> <th>Description</th><th>Booster Fans</th></tr> <tr> <td>(a) Mode of operation</td><td> i) two fans in parallel. ii) one fan (one stream in operation) </td></tr> <tr> <td>(b) Fan control system</td><td> i) capable of operating in automatic mode for all regimes of operation in a steady and stable manner ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR </td></tr> <tr> <td>(c) Vibration</td><td>For mounting of vibration pads/pickups (in the contractor's scope) flat surfaces shall be provided, both in X & Y directions, by the Contractor on the bearing housing in such a way, so that welding/screwing of the pads shall be possible.</td></tr> <tr> <td>(d) Bearing metal temperature monitoring</td><td>Shall be possible from remote as well as locally, using atleast 2 nos. of duplex platinum RTD's (100 ohms at 0 deg. C) per bearing</td></tr> </table>	Description	Booster Fans	(a) Mode of operation	i) two fans in parallel. ii) one fan (one stream in operation)	(b) Fan control system	i) capable of operating in automatic mode for all regimes of operation in a steady and stable manner ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR	(c) Vibration	For mounting of vibration pads/pickups (in the contractor's scope) flat surfaces shall be provided, both in X & Y directions, by the Contractor on the bearing housing in such a way, so that welding/screwing of the pads shall be possible.	(d) Bearing metal temperature monitoring	Shall be possible from remote as well as locally, using atleast 2 nos. of duplex platinum RTD's (100 ohms at 0 deg. C) per bearing
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(d) Bearing metal temperature monitoring	Shall be possible from remote as well as locally, using atleast 2 nos. of duplex platinum RTD's (100 ohms at 0 deg. C) per bearing										
4.08.00	The fans shall be suitable for parallel operation and sharing the load capacity over the entire range of operation without hunting. Pulsation shall be avoided by suitable design of fans and										
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.09.00	Fan Casing : (a) The fan casing shall be split to provide easy removal of the fan hub/impeller for replacement and repairs. (b) The sections shall have gasket joints to ensure airtight sealing. (c) Access doors shall be provided in each suction chamber casing and diffuser.			
4.10.00	Drain Connection: Drain connections shall be provided at bottom most point of the fan housing to the nearest trench.			
5.00.00	ABSORBER The unit shall be provided with an independent/dedicated absorber.			
5.01.00	The contractor may offer either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry, as per Bidders/Colaborator's proven practice. Only proven system in successful operation in previous installations supplied by the contractor shall be offered. A Spray System (i) The contractor shall provide spray system and minimum spray levels required to meet the stipulated guarantee and design requirement. The spray system (including slurry recirculation pump & nozzles) shall be sized to achieve a desired L/G ratio required to meet the guarantees SO ₂ removal efficiency, with redundancies specified under this clause. (ii) In case the contractor offers an absorber with multiple levels of spray nozzles, each spray level shall be provided with independent 2x100% pumps. Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity 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. The contractor shall provide spray system / spray levels only as per his proven practice, which should be in successful operation elsewhere. (iii) The slurry recirculation pumps shall have a minimum margin of 10% on flow and 10% on frictional head, over the actual requirement for meeting the guarantee and design point conditions. All slurry recirculation pumps including motors shall be of the same size and type.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.02.00	(iv) The slurry recirculation pumps shall have motor /pneumatic driven knife gate valve at pump suction and Motor/Pneumatic operated Butterfly Valves at discharge side as per the standard practice of bidder. In order to optimise power consumption of FGD system at part load operation, Bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD).			
	(v) The slurry recirculation pumps shall be wear-resistant and equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance. The slurry recirculation pumps shall be equipped with oil level indication, coupling guard and collecting equipment for leakage, made of resistant material. Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be provided.			
	(iv) The slurry pumps shall also comply with the requirements stipulated in Clause 8.00.00 of this sub-section.			
	(v) Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level.			
	B Bubbling Type Absorber 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 recirculating pump and spray header and nozzles shall be required in such case. However, 3 x 50% Gas Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping which are in contact with hot flue gas shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. Cooling Pump discharge piping and valves outside the flue gas path shall be in line with the requirements specified for slurry recirculation pumps. The Cooling Pumps shall be installed in a shed with roof sheeting. The sparger and gas riser tubes shall be made proven material which shall have a minimum life of 5 years. Minimum 10% of the number of Sparger Tubes required for one JBR to be provided as warehouse spares for the project in case JBR technology adopted by the Bidder. Absorber Recirculation Tank Sufficient number of agitators, as per the proven practice of the contractor, shall be provided for thorough mixing of the re-circulating slurry. In case the Contractor's 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 (n-total no. of working agitators). In case vertical agitators in Absorber are offered, one			
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	complete mechanical assembly of agitator shall be supplied as warehouse spare for each Absorber.			
5.03.00	Absorber Oxidation Systems			
5.03.01	The contractor may offer either a grid type oxidation system or a sparge jet oxidation system or lance type or air rotary sparge system or jet air sparger system for oxidation of sulfite sludge to sulfates, or any other proven system as per the practice of the FGD vendor.			
5.03.02	The oxygen required for oxidation shall be supplied by 2x100% oxidation air blowers for each absorber. The compressor/blower shall be sized to supply at least 2.5 times the stoichiometric air requirement for spray tower process & at least 4.0 times the stoichiometric air requirement for Bubbling Type process or the actual requirement, whichever is higher, under the following condition, all occurring simultaneously. The natural oxidation of sulfite by residual oxygen in flue gas shall not be considered for this purpose.			
	Load	Design point Flow		
	Flow	Minimum 2.5 times for spray tower process & 4.0 for Bubbling Type process the stoichiometric requirement		
	Head	For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher. Note: For unit sizes 250 MW & below, minimum 10% of the oxidation nozzles / sprayers or minimum 6500 mmwc whichever is higher. For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher.		
	Margin on Head	10 % margin on the higher value of above.		
	Ambient Conditions	45°C / 60% RH.		
5.03.03	Oxidation nozzles/spargers shall have a minimum redundancy as per the contractor's proven practice and justification to be provided during detailed engineering.			
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5.03.04	The oxidation system shall be complete with a quenching system to cool down heated oxidation air in order to prevent any scaling or buildup that could occur at the sparger tips due to localized evaporation of recycled slurry.													
5.04.00	Gypsum Bleed Pump Each absorber shall be provided with 2x100% Gypsum Bleed Pumps for supply of gypsum slurry to Gypsum Dewatering system. Each Gypsum bleed pump shall be sized to bleed-off the gypsum slurry from the absorber with slurry solid concentration not exceeding 30%, under the following conditions, all occurring simultaneously: <table><tr><td>Load</td><td>Design point</td></tr><tr><td>Flow</td><td>100% of gypsum produced at Design point condition</td></tr><tr><td>Head</td><td>As per system requirement</td></tr><tr><td>Margins</td><td>Flow -- 15%</td></tr><tr><td></td><td>Head – 20%</td></tr></table> The pumps shall be designed to meet the stipulations of Clause No.8.00.00 of this Sub-Section. Provision shall also be provide in the Gypsum Bleed Pumping system by provision of tap off, valves etc. for pumping the gypsum bleed to alternate source.				Load	Design point	Flow	100% of gypsum produced at Design point condition	Head	As per system requirement	Margins	Flow -- 15%		Head – 20%
Load	Design point													
Flow	100% of gypsum produced at Design point condition													
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Margins	Flow -- 15%													
	Head – 20%													
5.05.00	Emergency Spray System An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. The water shall be supplied from an elevated tank (emergency water tank) installed near to the absorber. The system shall be designed to fill/refill the emergency water tank in 2 hrs in case dedicated pump is used for filling of tank. The tank volume and the injection lances/nozzles shall be designed to protect the inlet duct and the lining of the absorber. The inlet duct shall be sloped towards the absorber. Spray line from Emergency water tank to flue gas duct shall be fitted with pneumatic valve only .													
5.06.00	Design													
5.06.01	The design and arrangement of the absorber shall be field proven for successful long-term operation in conjunction with a coal fired power plant.													
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:													
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	(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 $\pm 10\%$. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed. 5.06.03 The fabrication of the absorber vessel shall follow common practice as there shall be no longitudinal seams located behind any attachment or obstruction which would prevent inspection of the welds. Nozzles, access ways, and their reinforcements shall not be located in or on any seam. Inaccessible gaps or hollow beams shall be avoided. 5.06.04 The absorber shell shall be designed for pressure loads, piping forces and moments, wind and seismic loads and all other loads imposed on the absorber. Bracing and reinforcement shall be adequate to prevent deflection and vibration. Internal supports for mist eliminator sections, etc. shall be designed to withstand the flooded weight of the supported section. The absorber and its structural supports shall be designed for the maximum operating loads including design positive & negative internal pressure, static head, external attachment loads (such as exerted by piping) wind load using the allowable stresses permitted by the applied standards. 5.06.05 It shall be possible to reach the SO₂ emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service. 5.06.06 Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber. Provision shall be made for continuous washing of both ends of the first & second stage and the front section of the third stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the second stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. The automatic valve for the spray system shall be easily accessible on a platforms close to the mist eliminator. Entrained slurry shall be collected by mist eliminators downstream of the slurry spray system to avoid carry-over of slurry to the stack. The ME system shall be equipped with washing and drain provisions, where drains are directed into the absorber. Washing provisions shall include external and internal piping systems with replaceable nozzles, water pressure booster pumps (if required) complete with all piping, valves, instrumentation and controls. The mist eliminator wash piping/header shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same. Ease of replace ability and placement of the mist eliminator on maintenance platforms is an important requirement. The ME shall be designed to allow for			
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	efficient cleaning in process. Test ports shall be provided downstream of the mist eliminator to enable performance testing. The mist eliminator system shall be capable of withstanding high velocity spray water jets typically employed during manual cleanings. The ME shall be constructed in individual cells. The design shall safely avoid ME vibration and/or humming. The individual cells shall be sized so that no more than two maintenance personnel are needed to handle them manually when they are fully scaled or plugged, and the cells shall be capable of passing through the access doors for the mist elimination section. Easy access for placement and replacement of the mist eliminator shall be incorporated in the design of the mist eliminator arrangement and the absorber vessel. Walkways shall be arranged and also measures shall be taken as appropriate to permit the internal components to be disassembled and reassembled during repairs without the necessity for time-consuming preparatory work. The headroom shall have a height of more than 2200 mm. The mist eliminator support beams shall be designed to act as maintenance walkways approximately 300 mm wide and shall allow for a minimum 500 Kg/m2 load. The support beam/walkways shall provide personnel access to all mist eliminator modules, wash headers and wash nozzles. Adequate number of viewing ports with flushing devices connected to automatically operating washing system shall be delivered at following locations: (i) upstream of 1st stage (ii) between 1st and 2nd stage (iii) downstream of 2nd stage. (iv) downstream of 3rd stage The regular flushing shall be done in a defined time sequence.			
5.06.07	The absorber oxidation tank shall be provided with an over flow line (for spray tower process) complete with sealing pot, over flow and drain line. The absorber over flow shall be taken to a sump in the absorber region, from where the slurry shall be pumped back to the absorber by a sump pump.			
5.06.08	Materials used shall be suitable for the chemistry of the absorber process and resist abrasion from any particulate contained in the incoming flue gas and from the particulate of desulphurization process.			
5.06.09	All equipment located in the gas path or connected to such equipment shall be designed to withstand the maximum inlet gas temperature fluctuations. There shall be no damage whatsoever to any equipment as a result of these fluctuations.			
5.06.10	The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently.			
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.			
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	Alternatively, contractor can also offer Absorber vessel (absorber oxidation tank, absorber tower) of minimum 7 mm thick carbon steel lined with industrial grade chemically resistant glazed heavy bodied liner plate (ceramic tiles) joined by process and abrasive resistant mortar and the void between the liner plate is filled with cement to physically lock it into the vessel. In such a case, Contractor/Lining supplier shall provide a fifteen (15) year full replacement guarantee after the end of defect liability period and provide fulltime onsite QA supervision, during erection & commissioning by the supplier of the lining system. In this case bidder should submit a Bank Guarantee of Rs 50 million per absorber in support of above guarantee prior to the placement of order on the approved supplier for Ceramic Lining. However, the above bank guarantee will be forfeited in case availability of absorber found to be less than 95% annually during the 15 year guaranteed period. The above liner 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. Ceramic liner supplier must create/have created a Joint venture/ subsidiary in India for manufacturing and supply of ceramic liner for minimum 5000 m2 area ceramic liner meeting specification requirements base on his design, manufacturing and quality control system with in one year of date of award of first project. Ceramic liner supplier shall furnish bank guarantee of Rs 100 million prior to the placement of order on the approved supplier for Ceramic Lining in support of creating manufacturing facility in India. Bank guarantee shall be forfeited in case Ceramic line supplier fail to create such facility with in stipulated time. In case Ceramic liner supplier has already furnished the bank guarantee to NTPC through any contract for plant set up then Bank guarantee for plant set up is not required to submit again. Further, training of owner's O&M/QA team (minimum four man-days) and supply of manual for maintenance, repair & application of ceramic liner shall be provided by the ceramic liner supplier. Training and manuals shall also include preparation and application of chemical & abrasive resistant mortar for interconnection of tiles with each other and also cementitious backing grout for fixing of liner plate with the absorber. The liner plate should have following minimum properties: (a) Average value Compressive Strength Based on ASTM C 133 should exceeds 137 MPa (b) Boiling Water Absorption using ASTM Method C 67 should be less than 2.5% (c) Acid Solubility as Per ASTM C 279 maximum loss should be less than 12% after 48 hours in boiling 60Bé H2SO4 (78% by weight H2S04) Tile cementations backing grout material compressive strength shall be minimum 30 MPa. Chemical and Abrasion Resistant Mortar shall be used for joining the tiles having following minimum properties: (a) Tensile strength 13 MPa (b) Compressive Strength (ASTM C-306) 165 MPa (c) Water absorption (ASTM C-413) 0.2% (d) Adhesion to wire Cut Brick (ASTM C-321) 3.5 MPa (e) Total shrinkage upon setting and cure <1.0% Minimum 6mm thickness membrane is required over carbon steel shell as per manufacturers recommendation which shall have following minimum properties:			
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	(a) Tensile strength 1.4 MPa (b) Bond strength to steel 1.4 MPa. Further, supply of 2% of ceramic liner as mandatory spares in terms of installed ceramic liner area shall be in the scope of the bidder. 5.06.11 The material of process equipments of flue gas desulphurization system shall be appropriate for the chloride content and pH level at which the process is to operate. 5.06.12 All internal members shall be lined with minimum 2 mm Alloy 59/ C276 . All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276. 5.06.13 The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness. 5.06.14 The other bridges (supports) shall be lined with minimum 2 mm Alloy 59/ C276. 5.06.15 Lining material and technical application requirements shall be furnished by manufacturer experienced with similar FGD plants. Proof of such experience shall be provided by the Contractor. 5.06.16 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). Optionally ceramic coating is also acceptable provided bidder/Collaborator has proven experience for the same. The slurry spraying system shall be made of material resistant to erosion and corrosion. During the lifetime of the plant, only the nozzles shall be replaced. The distribution system of the slurry shall be hydraulically optimized. The spray nozzles shall be of silicon carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The design of the spray nozzles shall be such that rapid wear, encrustation and plugging are avoided. Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules. 5.06.17 In case the absorber is equipped with several spray levels they shall be designed as follows: (i) For spray type Absorber, the last spray level upstream the mist eliminator shall be operated only in counter-flow. (ii) Depositions at downstream spray level and mist eliminator by co-flow injection of slurry shall be avoided. (iii) The spray lances shall be equipped with bars for installation of scaffolding without any offset. The spray levels shall be designed for a load of min. 500 kgf/m². (iv) A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation. 5.06.19 The absorber shall be self-supported from the bottom to suit site conditions. Absorbers which are externally supported from the structure are also acceptable			
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	provided Bidder or its Technology Collaborator has proven experience of supplying such Absorbers which are operating for more than 5 years. The absorber shall have adequate stiffening arrangement on the external side. Internal stiffeners shall be used only where it is not possible to provide proper external stiffening with approval of employer.		
5.06.20	It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles.		
5.06.21	The spray piping, mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance.		
5.06.22	The bottom of the absorber sump shall be designed so that there will be an easy entrance for a man with a wheelbarrow. Therefore the arrangement and dimensions of the inspection door of the absorber at ground level shall be designed to allow for this. The bottom of the absorber sump shall be designed in such a way that complete drainage of the absorption liquid/slurry is possible and is accessible without damage of lining.		
5.06.23	In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. In case Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The Screens shall be made of made of Alloy 59 /C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collaborator has proven experience). For the agitators a flushing system for start ups shall be provided.		
5.06.24	It should be possible to discharge the absorber sump into the Auxiliary Absorbent tank within 2 hours.		
5.06.25	At the head of the absorber two manholes shall be provided to reduce the draught of the stack during outage.		
5.06.26	Equipment's required for internal & external inspection shall be furnished by the contractor in brand new condition. List of all such items shall be furnished along with the Bid. The formation of agglomeration, deposition & caking shall be avoided. For areas, where this might occur, (e.g. mist eliminators, spray levels) the Contractor shall submit a cleaning procedure including the required safety measures as part of the inspection concept.		
6.00.00	LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM		
6.01.00	Type A common limestone and slurry preparation system is envisaged for each project. Contractor shall supply wet limestone grinding and slurry preparation system complete with all auxiliaries and slurry storage tank of proven design.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.02.00	Limestone Silo:			
6.02.01	The Contractor shall provide 2X100% Limestone storage silos each silo having minimum 24 hours storage capacity equivalent to the requirements of FGD system of all the units operating at Design point. 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..			
6.02.02	The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 (Part 1 to 3). The storage silo shall be capable of feeding the limestone by means of gravimetric feeder to the wet ball mills. The top of the unloading hopper shall be equipped with a grate to protect the downstream equipment from gravel lumps or tramp waste.			
6.02.03	Each Silo shall be provided with minimum 02 no. of Level transmitters per silo.			
6.02.04	Each silo shall be provided with minimum 3nos. of air canons at necessary location, capable of removing the jamming/clogging/blockage in the silos.			
6.02.05	For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.			
6.02.06	For each silo facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes.			
6.02.07	Lime stone silo with hopper may be fabricated at factory in segments, transported and welded at site.			
6.03.00	Bunker Shut-off Gates			
6.03.01	A bunker outlet chute shall be provided for feeding limestone from bunker to the feeder. The size of the opening chute shall be sufficient to ensure proper flow of the limestone. There shall be no reduction of section in the bunker outlet chute from bunker to feeder. The inlet chute shall be provided with suitable poke doors/holes in order to remove jamming/blockage. A motorized bunker shut-off gate shall be provided at the inlet to each feeder.			
6.03.02	All parts of the gate in contact with limestone shall be of stainless steel construction.			
6.03.03	The shut-off gates and its actuator shall ensure 100% closing of the gate even with 'bunker full of limestone'.			
6.03.04	Facility shall be provided to open/close the bunker outlet gate, through actuator, from remote as well as local.			
6.03.05	In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of limestone.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
6.03.06	For each bunker facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes.			
6.04.00	Gravimetric Feeders			
6.04.01	Gravimetric feeders shall be sized to meet 110% of the maximum mill capacity.			
6.04.02	The limestone feeder belt shall be of seamless rubber construction. It should be possible to adjust the belt tension from outside without opening the feeder body.			
6.04.03	All parts in contact with limestone except belt shall be of stainless steel construction.			
6.04.04	The feeder shall have adequate instrumentation to detect `loss of flow`.			
6.04.05	The feeder shall have a motor/pneumatic operated gate at the outlet.			
6.05.00	Wet Ball Mill			
6.05.01	There shall be 2X100% wet Ball mills for grinding of limestone. Each mill shall be sized to meet 110% of the maximum limestone requirement of all the units in a project operating under the following conditions, all occurring together.			
	(i)	Load	Design point flow	
	(ii)	Flow	110% of limestone requirement of all the absorbers at Design point	
	(iii)	Input Limestone Size	1" (max.)	
	(iv)	Output Fineness	Output Fineness 90% or higher (as per the requirement of 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)	
	(v)	Mill Wear Part Conditions	Near Guaranteed Wear Part Life.	
	(vi)	Limestone bond index(kWh/sh.T)	13 (min)	
6.05.02	All integral auxiliaries of the mills like hydro-cyclones, separator tank & mill circuit pumps shall be sized to meet the above conditions. A 100% stand-by pump shall be provided for the mill circuit pump.			
6.05.03	The mill hydro-cyclone set shall have sufficient redundancy. A minimum 10% spare hydro-cyclone shall be provided in each set of hydro-cyclone. Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The hydro-cyclone shall be of proven design			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
6.05.04 6.05.05 6.05.06 6.05.07 6.05.08 6.05.09 6.05.10 6.06.00 6.06.01 6.06.02	and shall be provided with replaceable rubber lining. The hydro-cyclone shall be provided with replaceable rubber lining of thickness 12 mm for the feed chamber and 12 mm for the overflow launder.. The liners shall have a minimum wear life of not less than 8000 hrs. All parts of the mill including mill body, trunnion, hydro-cyclones, integral pipes, mill circuit pumps and other parts in contact with limestone slurry shall be provided with replaceable rubber wear liners. The wear liners or wear parts shall have a minimum guaranteed wear life of not less than 8000 hrs without reversal of the liners. The guaranteed capacity and fineness of the mill shall not be affected within the guaranteed life of the mil wear parts. The material of the balls shall be chosen to ensure that the balls do not lose their original shape and to ensure minimum ball consumption. The contractor shall also guarantee ball consumption per ton of limestone throughput. The contractor shall furnish the minimum ball diameter below which the balls shall be replaced. Facility shall be provided for on-load loading of steel balls to the mill. The ball mill shall be driven by a motor through a peripheral gear/ central drive system. An auxiliary motor shall also be provided for inching of mills after trip and during maintenance. The lube oil system shall have 100% stand-by arrangement for lube oil pumps and oil coolers of each circuit with independent pump / cooler. Wherever required duplex oil filters shall be provided. The mill auxiliaries like separator tanks, mill circuit pump, hydro-cyclones and all connecting pipes handling limestone slurry shall have replaceable rubber linings. The design and manufacturing of wet ball mill shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards. Limestone Slurry Preparation / Storage Tank The contractor shall provide two (2 nos.) slurry storage tank, common for all mills. Each tank shall be sized to meet 12 hours continuous limestone requirement of all the units operating at Design point. For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower. The storage tanks shall be equipped with sufficient number of agitators, to avoid settling of limestone, as per the proven practice of the supplier. The agitators shall be designed to meet the requirements stipulated in Cl. No. 11.00.00 of this Sub-Section.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.06.03	The limestone mill circulation tanks shall be installed indoor beneath the hydro cyclone stations. The slurry storage tank shall be located outdoor.		
6.06.04	The slurry preparation tank shall be CS construction with replaceable chlorobutyl/bromobutyl rubber lining of minimum 5 mm thickness.		
6.07.00	Limestone Slurry Supply Pumps & Piping		
6.07.01	2x100% centrifugal type limestone slurry pump shall be provided for each unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together.		
	(i)	Load	Design point
	(ii)	Flow	110% of one absorber requirement with the limestone requirement at Design point.
	(iii)	Head	As per system requirement.
	(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)
	(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.
6.07.02	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.8.00.00. of this Sub-Section.		
6.07.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.		
6.07.04	Automatic flushing equipment for all lime slurry pumps and pipes shall be supplied.		
7.00.00	GYPSUM DEWATERING SYSTEM		
7.01.00	A common gypsum dewatering system for all the units operating at Design point is envisaged. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber up to less than 10% moisture. All the equipments supplied shall be proven design with previous installations for similar capacities.		
7.02.00	The Contractor shall provide 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating at Design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS											
7.03.00	Primary Dewatering Hydro-cyclones											
7.03.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by all the units operating at Design point with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters.											
7.03.02	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.											
7.03.03	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing.											
7.03.04	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.											
7.03.05	The hydro-cyclone shall be of proven design. The primary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The feed chamber shall be provided with a minimum rubber lining thickness of 12mm. The liners shall have a minimum wear life of not less than 7000 hrs.											
7.04.00	Vacuum Belt Filters											
7.04.01	Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: <table><tr><td>a. Capacity</td><td>110% of gypsum produced by Absorbers of all the units operating at Design point.</td></tr><tr><td>b. Outlet Moisture</td><td>10% max.</td></tr><tr><td>c. Gypsum Purity</td><td>90% (minimum)</td></tr><tr><td>d. Chloride content</td><td>< 100 ppm</td></tr></table>				a. Capacity	110% of gypsum produced by Absorbers of all the units operating at Design point.	b. Outlet Moisture	10% max.	c. Gypsum Purity	90% (minimum)	d. Chloride content	< 100 ppm
a. Capacity	110% of gypsum produced by Absorbers of all the units operating at Design point.											
b. Outlet Moisture	10% max.											
c. Gypsum Purity	90% (minimum)											
d. Chloride content	< 100 ppm											
7.04.02	The vacuum belt filter shall be proven design in operation for similar capacities. The design, manufacture, installation and testing of Vacuum Belt Filters shall follow the latest applicable Indian / International (ASME /EN / Japanese) Standards. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.											
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
7.04.03	The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material.
7.04.04	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be single piece, factory or Site vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.
7.04.05	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
7.04.06	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.
7.04.07	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. For cake washing only clarified water shall be used. For this purpose, one (1) clarified water storage tank (minimum 1 hr storage) shall be provided along with 2x100 cake washing pumps for each Vacuum Belt Filter . One stage of cloth washing arrangement shall also be provided along with 2x100 cloth washing pumps for each Vacuum Belt Filter.
7.04.08	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
7.04.09	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Contractor.
7.04.10	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components of the belt shall also be provided.
7.04.11	The design and manufacturing of vacuum belt filter shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.
7.05.00	Vacuum System
7.05.01	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice.
7.05.02	Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump.
7.05.03	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design.
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7.05.04	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.			
7.05.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.			
7.05.06	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.			
7.06.00	Filtrate System			
7.06.01	Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks.			
7.06.02	2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case.			
7.06.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump.			
7.07.00	Waste Water System			
7.07.01	The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones.			
7.07.02	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank.			
7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones.			
7.07.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.07.05	The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a waste water tank.			
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	In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable .However, the required moisture content in Gypsum & required Gypsum quality shall be complied.			
7.07.06	1x100% Waste water tank shall be provided which shall be sized for 8 hrs storage of waste water with all the units operating at Design point and no out flow from the tank. The Waste water Tank shall be complete with Agitator, level transmitters etc. The waste water collection tank shall be of Steel construction with Vinyl Ester based flake glass lining of minimum 3 mm thickness. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. The material of Casing and impeller shall be rubber lined Cast Iron (IS:210 Gr FG260). Shaft shall be 410 & Shaft Sleeves shall be of Stainless Steel - 316.			
7.07.07	All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. Contractor shall provide the complete lime dosing system to correct the pH of the waste water by lime (83% purity) dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room.			
7.07.08	Contractor shall provide 2x 100% Lime Neutralization tanks which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank.			
7.07.09	Contractor shall provide 2x 100% Lime Storage Silos for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of all the units at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc. Hydrated lime shall be supplied by the employer in the form of bags. For sizing purpose, bulk density of hydrated lime shall be considered as 480 kg/m3. For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.			
7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2 hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.07.11	A storage room for storing minimum one (1) month requirement of lime for all the units shall also be provided by the contractor.			
7.08.00	Auxiliary Absorbent Tank			
7.08.01	The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge each absorber into the Auxiliary Absorbent tank within 2 hours up to the suction line of the intended pump. Further, Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.			
7.08.02	The contractor shall provide 1 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.			
7.08.03	Agitation shall be provided to prevent settlement of slurry by top entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down.			
7.08.04	The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber.			
7.08.05	The Auxiliary Absorbent tank shall be equipped with an opening to enable easy entry of a man with wheelbarrow.			
7.08.06	Suction screens shall be installed to protect the pump.			
8.00.00	SLURRY PUMPS			
8.01.00	This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone slurry feed pumps, Mill circuit pumps and any other pump handling slurries.			
8.02.00	The Contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
8.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head .Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps, wherever not specified. The slurry concentration in the pump shall not exceed 30% by weight except for Mill circuit slurry pumps for			
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	which the slurry concentration in the pump shall not exceed 55% by weight. 8.04.00 All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/ pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder. 8.05.00 In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller. 8.06.00 All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer an Hi-chrome casing or Hi-chrome alloy lined pump if the bidder has previous experience of the same for similar applications. 8.07.00 For absorber recirculation service a Silicon carbide/hi-chrome impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service. 8.08.00 In case of Hi chrome casing pump the Guaranteed wear life of casing shall not be less than 24000 hrs. In case of lined pump the Guaranteed wear life of liner and other wear parts of the pump shall not be less than 14000 hrs. 8.09.00 The design of the shaft shall ensure that the critical speed is atleast 20 % above the operating speed of the shaft. 8.10.00 The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings. 9.00.00 VERTICAL SUMP PUMPS 9.01.00 Contractor shall make arrangements for pumping the drainage water back to the respective system with 2X100% vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump. This Clause covers the design, manufacture and erection of all vertical sump pumps for the FGD system. 9.02.00 The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards. 9.03.00 The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal. 9.04.00 The pump shall deliver the rated flow at rated head. Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for			
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	selection of pumps wherever not specified. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.			
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.			
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.			
10.00.00	SLURRY & PROCESS WATER TANKS			
10.01.00	All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with the following: Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank: Vinyl Ester based flake glass lining / Polymeric Epoxy of minimum 3 mm thickness Slurry tanks: Replaceable Chlorobutyl/ Bromobutyl rubber lining of minimum 4 mm thickness The outside surface of the tanks shall be coated with paint as approved by the Employer. Coarse-screen(s) at suction-side of slurry recirculation pumps shall be provided.			
11.00.00	AGITATORS			
11.01.00	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.			
11.02.00	All agitators shall be designed for continuous operation unless otherwise specified. Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type.			
11.03.00	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.			
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11.04.00	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.		
11.05.00	The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials.		
11.06.00	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the absorber vessel without having to drain completely the absorber.		
11.07.00	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.		
11.08.00	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.		
11.09.00	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.		
11.10.00	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.		
11.11.00	All exposed moving parts shall be covered by guards.		
11.12.00	Side entry agitator shall be flange mounted.		
11.13.00	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.		
11.14.00	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions		
12.00.00	SLURRY LINES AND VALVES		
12.01.00	Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve / restriction orifice made of erosion resistant material for the above purpose.		
12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes size up to 400NB made up of FRP material as per ASTM 2310 and testing as per ASTM B2583 (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.		
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12.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.			
12.04.00	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.			
12.05.00	Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipments etc.			
13.00.00	PROCESS WATER STORAGE TANKS & PUMPS			
13.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of all the units operating at Design Point) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of all the units operating at Design Point) along with all necessary piping, valves, control & instrumentation to feed the clarified water shall be provided by the Contractor. Process water Storage level shall be automatically controlled at operating level by controlling the water flow from the makeup water from terminal point. The process water storage tank shall be designed to store 15 minutes of total maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for the units operating at Design point. All the process water storage tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tank shall receive water supplied (as identified in Subsection titled "Terminal points" in Part-A of Technical Specification) by Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.			
13.02.00	2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit. A further 10% margin shall be provided over the above capacity for all the above pumps.			
13.03.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. Each pump shall cater to maximum mist washing requirement of one unit. The capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the maximum			
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	wash water requirements of mist eliminators of the absorber. A further 10% margin shall be provided over the above capacity for all the above pumps.			
13.03.04	Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps from terminal point shall be provided by the Contractor. The two tanks shall be interconnected with an isolation valve.			
13.03.05	2x100% clarified water Pumps connected to each of the clarified water Storage tanks for each dewatering stream. Each pump catering to clarified water requirement of each dewatering stream.			
13.03.06	The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.			
13.03.07	All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with replacable chlorobuty/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness or Epoxy lining minimum three coats of 150 micron thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.			
14.00.00	Approach and Handling Facilities			
14.01.00	Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations specified elsewhere in this specification.			
14.02.00	Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable.			
14.03.00	Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided			
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	above each spray level. Ladders/staircase shall be provided for the access to the platform.		
14.04.00	The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.		
14.05.00	A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.		
14.06.00	Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach along with suitable platforms shall be provided for ball loading hoppers.		
14.07.00	A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.		
14.08.00	A 2000 mm wide floor/platform shall be provided all around each belt filter.		
14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc., are included in Contractor's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc.		
14.10.00	The regular basement floor is not acceptable in FGD area. Further local Pits/trenches shall be avoided as far as possible.		
14.11.00	Handling arrangement of milling system, Booster fans, Slurry recirculation pumps, oxidation blower, belt feeder system etc. complete with crane/monorail along with removal space for maintenance shall be provided by the Contractor.		
14.12.00	Approach for removal of equipment for maintenance shall be provided.		
14.13.00	All other safety requirements as per the Factories Act, National Electricity code shall be complied with while developing Layout.		
14.14.00	Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC.		
14.15.00	Each Equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and Statutory bodies/insurance companies.		
14.16.00	Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M.		
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14.17.00	Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the Contractor. The clear head room for the same shall be minimum 8 M.		
15.00.00	ELEVATORS		
15.01.00	Elevators shall be designed based on following criteria :		
	(i) Type of service	One (1) no. Passenger cum goods elevator per Absorber (higher than 15 m), Mill Building and Dewatering Building.	
	(ii) Design/construction/installation codes	(a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666, IS:1860 and IS:3534. (b) Any other equivalent code, subject to Employer's approval Load carrying capacity	
	(iii) Capacity	1000 kg (minimum).	
	(iv) Rated speed	1.0 m/s.	
	(v) Total Travel	As per FGD supplier's recommendations subject to Employer's approval.	
	(vi) Number of floors to be served	As per requirement and subject to Employer's approval	
	(vii) Entrance	As per requirement and subject to Employer's approval	
	(viii) Entrance and platform size	As per design/installation codes at (ii) above	
	(ix) Drive/motor	As per Electrical Specifications.	
	(x) Method of control	As per Electrical Specifications.	
	(xi) Machine room and lift Shaft	Pressurized dust proof or Airconditioned machine room as per the requirement of lift manufacturers.	
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	(xii) Position of machine room	Directly above the lift shaft.		
	(xiii) Power Supply	As detailed in Electrical Specification		
15.02.00	Landing doors of the elevators shall have fire resistance of at least one hour. These doors shall also be smoke tight as far as possible.			
15.03.00	Construction of the elevators shall specifically meet all requirements of the codes indicated at Cl. 15.01.00 (ii) and shall have following additional features:			
	(i) Flooring of Cabin	:	6 mm thick Checkered Plate flooring.	
	(ii) Design, Construction and finish of car & car door	:	Car inside enclosure including inner side of door shall be of stainless steel plate of grade SS:304 of bright finish.	
	(iii) Car entrance and landing doors	:	As per BS:476 (Part 20 & 22)	
	(iv) Door construction	:	Hollow metal construction from 16 guage thick steel sheet spray painted.	
	(v) Signals	:	Car position informer in car both visual and audio, hall position indicator at all floors, telltale lights at all floors, battery operated alarm bell and emergency light with suitable battery, charger & controls.	
	(vi) Type of Indicators	:	Soft touch keys and digital luminous display in car operating panel and on all floors landings. (All fixtures in stainless steel face plates).	
15.04.00	Technical requirements of Electrical items shall be as per details given in Electrical Sub-Section, Part-B.			
15.05.00	Provide sound reducing material below machines in machine room.			
15.06.00	Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's approval.			
15.07.00	Elevators shall have provisions to meet following operational requirements:			
	(i)	Selective collective, automatic operation with or without operator through illuminated push button station located inside the lift car.		
	(ii)	Power operated with automatic opening/closing car and landing doors.		
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15.08.00	(iii) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing, and one push button at each terminal landing shall be provided in order to call the car. (iv) Push buttons shall be fixed in the car for holding the doors open for any length of the time required. Fireman's switch shall be provided for each elevator.
16.00.00	DUCT WORK AND DAMPERS:
16.01.00	Duct Work
16.01.01	Sizing Criteria:
	1. Allowable velocities in the duct work. Maximum gas velocity shall be 15 m/sec at Design point condition.
16.01.02	Loads for Duct and Structure Design The duct design shall take into account following loads all occurring together: 1. Wind loads as specified. 2. Dead weight including weight of insulation, lining, wash water and the vertical live load. 3. Ash load : All ducts to be designed for one tenth of duct full of ash. The ash density for the purpose of loading shall be at least 1300 kg/m³. 4. Expansion joint reaction. 5. Seismic Load 6. The following minimum load factors shall be applied to the design loads: Temperature (Deg.C) : 27 38 93 149 205 260 316 321 Load Factor : 1.00 1.02 1.12 1.19 1.25 1.29 1.34 1.42

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	be designed for + 660 mm & - 150 mm wg or maximum conceivable pressure of the Booster Fan, whichever is higher, at 67% of yield strength of material.			
16.01.04	Duct Slope All ducts shall have a sufficient slope with respect to horizontal so that any chance of accumulation of ash particles or water in the duct can be avoided under all normal/abnormal operating conditions. The inlet duct shall be sloped towards the absorber.			
16.01.05	Type of duct construction: The duct shall be of rectangular cross-section and shall be of all welded construction. For rectangular ducts following requirements shall be complied with: a) Minimum 7 mm thick steel plates for gas ducts & Duct stiffening shall be by means of rolled sections of duct material. b) A corrosion allowance of 1.5 mm shall be considered for stress calculation for the flue gas ducting. c) Duct stiffening shall be by means of rolled sections. No internal stiffeners shall be used for ducts from Absorber outlet to chimney inlet.			
16.01.06	Insulation & Lagging a) Thermal insulation shall be applied to all air/gas ducts to comply with the requirements of as specified at clause no 17.00.00 of this chapter. b) Acoustic insulation shall be used, if required, in gas ducts to restrict the noise level to specified values.			
16.01.07	Specific Requirements a) The stiffeners provided on the ducts walls shall be of such a design and layout that no rainwater can accumulate on the duct surfaces. b) The flanges at the bolted joints shall have adequate stiffeners to avoid damages to the flanges. c) All necessary wall boxes and floor collars shall be provided where the ductwork pass through walls, floor and roof. d) The floor collars shall be fitted with a high combing to prevent water and dust falling through the hole. e) The ductwork shall be fitted with a steel hood to cover the opening. f) Weatherproof flashing shall also be provided wherever necessary.			
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16.01.08	g) The configuration and design of ducts shall be coordinated with the pulveriser parts removal requirement. h) Air and gas ducts shall not counter internal bracings, which cause excessive pressure drop. i) Duct plates shall be designed for one-way beam action over stiffeners and considered fully continuous over all supports. j) Bidder to ensure proper draining facilities for the complete system including proper drainage of acidic fluids from the ducts so as to avoid any accumulation of acidic fluids. k) The deflection of the plate, assumed continuous, shall be less than one-half the plate thickness.			
	Duct Work Structure a) Ductwork sections between expansion joints shall be investigated with regard to their ability to transmit loads to supports. Care shall be exercised to identify uplift condition. b) Internal stiffeners: (i) Duct shape shall be maintained by providing internal stiffening elements at or near supports. However, these internal stiffeners shall be used, if and only if, it is not possible to provide external stiffeners. (ii) Internal stiffening elements shall consist of trusses, preferably comprised of extra-strong steel pipes (min. dia. 76.2 mm) acting in conjunction with external stiffeners. Such internal stiffeners for the flue gas duty between boiler and ESP shall be provided with erosion protection shields. (iii) The number of internal trusses shall be limited to the minimum required for structural integrity and shaped so as to offer least resistance to gas flow and to minimize the accumulation of fly ash in the bottom of duct. (iv) Conceptual data of internal stiffeners of the ducting shall be furnished along with the offer. (v) All the detailed design data shall be furnished to the Employer before the duct support column foundation data submission. c) Corner angles shall be used on all inside corners of all ducts to provide adequate continuity.			
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16.01.09	d)	Inside welds of corner angles to duct plate shall be continuous and seal welded. Where inside surface of ducts will be coated, welds shall be full throat.						
	e)	Field welding and all connections of bracing (stiffening elements) to stiffeners shall be well designed in order to develop full strength of the members. The gusset plates shall be of 10 mm minimum thickness.						
	f)	The duct, plates, trusses, stiffeners, bracings and ductwork shall be designed as structures in accordance with relevant Indian Standards.						
	g)	All openings in ducts shall be reinforced for all design loads.						
	h)	Ductwork supports may be hangers or sliding bearing, guides and anchorages. A coefficient of sliding friction of 10% can be used with self-lubricated plates such as "LUBRITE" or "MECHANITE", a coefficient of sliding friction of not less than 35% shall be used for steel-on-steel contact. The allowable bearing stress for self-lubricated plates shall be 70 Kg/sq.cm.						
	Fabrication Requirements							
	a)	Fabrication shall be as per IS specification for Design, fabrication and erection of 'Structural Steel for Building.						
	b)	Welding shall be in accordance with Section IX of ASME code.						
	c)	Ducts shall be strength welded and seal welded to produce a gas tight duct. Alignment holes shall be provided in mating flange sections.						
	d)	Ducting shall be detailed and fabricated in a few pieces as practical, taking into account, shipping and erection considerations.						
17.00.00	e)	Materials improperly detailed or fabricated necessitating extra work during erection on field, shall be the responsibility of the Contractor.						
	THERMAL INSULATION AND CLADDING							
	17.01.00	Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius except for absorber. Further, Thermal insulation of min 75 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature.						
		The specification of the insulation including type, density, thickness, heat conductivity and finish shall be designed based on criteria specified below. The insulation thickness shall be designed based on following criteria.						
		<table><tr><td>Criteria</td><td>Design Conditions</td></tr><tr><td>(i) Ambient Temperature</td><td>45°C</td></tr></table>			Criteria	Design Conditions	(i) Ambient Temperature	45°C
		Criteria	Design Conditions					
		(i) Ambient Temperature	45°C					
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17.02.00	(ii)	Surface wind velocity	0.25 m/sec.		
	(iii)	Emissivity of Aluminium	0.2		
	(iv)	Cladding surface temperature	60°C (max.)		
	(v)	Thermal conductivity of insulation material	Not less than the Maximum values as per IS:8183		
	(vi)	Pipe/Equipment wall temperature	Maximum fluid design temperature		
	(vii)	Overall heat transfer coefficient and insulation thickness	To be calculated as per ASTM C 680-89		
	However, the minimum insulation thickness, however, shall not be less than 75 mm.				
	Material and application of insulation material, protective cladding, wire mesh etc. shall be conforming to latest edition of following codes:				
	(a)	IS:8183			
	(b)	IS:3677			
17.03.00	(c)	IS:3144			
	(d)	IS: 14164			
	(e)	IS:280			
	(f)	ASTM-B 209			
	Insulation material for all equipments, ducting, etc. shall conform to following requirements:				
	Parameters		Requirement		
	(i)	Material	(a) Lightly resin bonded mineral wool of best grade conforming to IS:8183. (Hand made mattresses is not acceptable). Material shall be rock wool only. Slag wool or slag wool inclusion shall not be accepted.		
			(b) Lightly resin bonded glass wool mattress, having density 64 Kg/m³ (min.), self stitched in shop can also		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.04.00		be accepted for temperature less than 400°C.		
	(ii)	Bulk density of lightly resin bonded mineral rock wool mattresses		
	(a)	For use upto 400°C	- 100 Kg/m³	
	(b)	For use above 400°C	- 150 Kg/m³	
	(iii)	Physical requirements -		
		Following shall be met by testing as per relevant clauses of IS:3144.		
	(a)	Shot content	5% by weight (maxm.), size of any shot not to exceed 5 mm in diameter	
	(b)	Bulk density	To comply with 16.03.00(i) & (ii) above.	
	(c)	Weight gain by moisture absorption	2% (maxm.)	
	(d)	Sulphur Content	Not exceeding 0.6%	
	(e)	Alkalinity as percentage of Na ₂ O	Not exceeding 0.6%	
	(f)	Maximum oil content	Not exceeding 0.3% by weight	
	(g)	Total carbon content	Not exceeding 0.3% by weight	
	(h)	Settlement	Nil (When tested as per Cl. 21.1 & 21.2 of IS:3144)	
	(i)	Handability	Fully handable, without any lump formation and disintegration of material	
(k)	Loss of weight after combustibility test	Not exceeding 5% by weight		
	The Insulation mattress shall be rated incombustible when tested by the method prescribed in clause 15 of IS:3144 and shall meet the requirement of the Mercantile			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.05.00	Marine department, Lloyd's Register of shipping, underwriter, fire hazards codes and other International standards. In addition to requirements as mentioned above, insulation material (and protective covering) shall: (a) Be fresh, incombustible, rust proof, non hygroscopic, (b) Be capable of withstanding continuously and without deterioration the maximum temperature to which they will be subjected. (c) Not react chemically, either to itself or with other components. (d) Not sustain any fungi, or vermin and must not pose health hazards.			
17.06.00	The Mineral wool shall: (a) Pass standard combustibility test both immediately after application and after subjected to maximum operating temperature for not less than 100 hrs. (b) Not suffer permanent deterioration as a result of contact with moisture due to condensation and shall be free from objectionable odor. (c) Not cause corrosion of the surface being insulated or of cladding on it under normal site conditions. (d) Not suffer any quality deterioration under specified service conditions (both cold/hot face temp.) of use.			
17.07.00	The use of insulation of finishing materials containing asbestos in any form is not permitted.			
17.08.00	Insulation mattress/section shall be supplied in thickness of 25,40,50 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/slabs of thickness specified above. However, if the required thickness is such that by using above mattress/slabs the calculated thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable for outer layers. The min. thickness however, shall not be less than 25 mm and number of layers shall be minimum and innermost layer shall be thickest.			
17.09.00	Sheathing Material Sheathing material for all insulated surfaces, equipments, piping etc. confirming to ASTM B-209-1060 temper H-14 or IS:737 Gr 19000/H2, shall be provided. The thickness of aluminium sheathing to be used shall be 22 SWG (0.71mm).			
17.10.00	Binding and lacing wires shall be 20 SWG Galvanised Steel wire			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
17.11.00	All Straps and bands shall be Galvanized Steel. Bands shall be 20 mm wide and 0.6 mm thick. For securing Aluminum sheathing material, stainless steel or anodized aluminum bends shall be used.			
17.11.01	Screws shall be of galvanized steel, check headed, self tapping type. Above 400 degree Celsius temperature, screws shall be stainless steel.			
17.12.00	Hexagonal wire mesh netting shall be 10-13 mm aperture and atleast 0.56mm diameter conforming to following Galvanized Steel wire.			
17.12.01	Non metallic components like 3 mm thick mill board, aluminum pigment sealant, white glass cloth, insulating cement, neoprene washer shall be provided.			
17.13.00	Application of Insulation			
17.13.01	General			
	(a) All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, rust etc. and shall be dry before the application of insulation.			
	(b) Before applying the insulation the contractor shall check that all instrument tapping, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.			
	(c) All flanged joints shall be insulated only after the final tightening and testing.			
	(d) The insulation shall be applied to all surfaces when they are at ambient temp. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking/telescoping due to alternate periods of expansion and contraction.			
	(e) All cracks voids and depressions shall be filled with finishing cement, suitable for the equipment operating temp. so as to form a smooth base for the application of cladding.			
17.13.02	All the refractory and insulation materials required for complete field application of insulation, cladding etc. covered under these documents and specifications shall be furnished with the equipment. They shall conform to the requirements of the various relevant ISI standards or other approved equivalents. All items such as insulating cement, sealing material, insulation material, screws, washers, etc., needed to complete the work in the course of the application of insulation and refractory shall be furnished. All insulating materials shall be chemically inert in both the dry and wet state and shall withstand the full working temperature conditions to which they are exposed without any deterioration. The gas ducts shall be insulated with mineral wool block or mineral wool blanket and all other equipment operating at elevated temp. not enclosed in the boiler casing shall be insulated with calcium silicate blocks, mineral wool blocks or mineral wool blanket insulation.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.13.03	Application on Piping			
	(a) All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/crushing of insulation due to its self weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3 m straight length between support rings. (b) Longitudinal joints of insulation mattress sections of horizontal piping shall be on the bottom or at the sides of the pipe. (c) When more than one layer of insulation mattress/section is required on piping the circumferential joints on adjacent layers shall be staggered by at least 150 mm and longitudinal joints shall be staggered by at least 50 mm. (d) The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire. Pipe section insulation shall be fitted on pipe using binding wires. (e) Where insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh. (f) The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement. (g) Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts. (h) The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter upto and including 550 mm and with metal bends for insulation surfaces with diameter over 550 mm. The fastening shall be done at intervals of 250 mm except where specified otherwise. The ends of the binding wires shall be hooked and embedded in the insulation. The straps shall be mechanically stretched and fastened with metallic clamping seals of the same materials as the strap. (i) Insulation for application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. After the application of insulation material place, insulating cement shall be applied as required to obtain a smooth surface. (j) Weather hoods shall be provided for insulated piping passing through floors/walls.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.13.04	(k)	All pipe attachments coming on horizontal pipes, inclined pipes and bends shall be insulated along with pipe such that there will be no insulation applied to hanger rod and the component connecting hanger rod to pipe attachment. All pipe attachments exposed to weather shall be provided with weather proof covering.		
	(l)	Upstream of all drain lines and the lines connected to steam traps, shall be insulated upto and including first isolating valve for heat conservation. Rest of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges, vents, etc. shall be insulated for personnel protection.		
17.14.00	Application on Valves and Fittings			
	(a)	All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provisions and or exceptions as given below.		
	(b)	All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminium sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be bevelled back to permit removal bolts and nuts or bands. The portion of the valve which can not be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valves/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.		
	(c)	Flanges on lines having temperature upto and including 150 deg.C shall not be insulated.		
	(d)	Union shall not be insulated.		
	(e)	Expansion joints, metallic or rubber, shall not be insulated unless otherwise specifically indicated.		
	(f)	Safety valves shall be insulated.		
17.14.00	While applying mineral wool blanket insulation:			
	(a)	Provide expended metal or hexagonal wire mesh on both sides for single layer mattress and on first layer in case of multilayer insulation. Subsequent layers of multilayer insulation to have only one side wire netting.		
	(b)	The edges of adjacent blankets to be leased together, by appropriate lacing wire as per Clause 16.08.00.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.15.00	(c)	Any gap between joints between insulation layers shall be filled by loose mineral wool confirming to IS:3677.		
	(d)	All insulation to be secured by 1.63 mm dia wire netting over blankets with ends of wire tightly twisted, and pressed in to insulation surface.		
	(e)	Impelling pins shall be placed on centers not exceeding 300 mm.		
17.16.00	Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in Clause 18.09.00.			
17.17.00	Application of Metal Cladding			
	All insulated surfaces of the FGD shall be provided with metal cladding in accordance with the following requirements.			
	(a)	All insulation procedure of metal cladding shall have prior approval of the Owner.		
	(b)	All insulated surfaces of FGD shall be covered with aluminium cladding.		
	(c)	Cladding for FGD components are to be finished with plain aluminium sheeting of thickness not less than the values specified. Wherever an inner casing plate is necessary to effect a gas tight enclosure, the plate shall be of mild steel of required thickness, but not less than four (4) mm suitably stiffened and supported.		
	(d)	Cladding on straight surfaces shall be finished with aluminium sheeting of at least 20 SWG thicknesses suitably pressed along diagonals to form diamond shape or otherwise formed.		
	(e)	Cladding for insulated circular surfaces will be constructed from aluminium sheets of thickness not less than 20 SWG.		
17.17.00	(f)	Weather proof flashings shall be installed where the panels intersect with columns and at other similar joints.		
	Application			
	All metal cladding shall be fabricated and installed to ensure a neat appearance and no open ended sections of cladding shall be left uncovered. The following provisions shall also be complied with:			
17.17.00	(a)	All closures, flashings and seals required shall be provided and installed.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b) An asphalt and craft paper moisture barrier shall be provided to the aluminium cladding for all out door applications. Such moisture barriers shall be fixed to the inner surface of the cladding or shall be cemented to the outside surface of the insulation before application of cladding. (c) All the used in the out door cladding shall be provided with Neoprene washers. (d) All openings and joints in outdoor cladding for piping connections, supports or access shall be suitably flashed and weather-proofed. Where such flashings or weather-proofing can not effectively control the entry of moisture, then such openings and joints shall be weather-proofed by application of aluminium pigmented sealer. (e) Cladding on the top surfaces of the FGD, duct work and equipment shall be suitably reinforced to prevent damage by personnel walking thereon.			
17.18.00	Protection of Equipment during insulation application All equipment and structure shall be suitably protected from damage while applying insulation. After completion all equipment and structures shall be thoroughly cleaned of insulating materials which might have fallen on them.			
18.00.00	TYPE TEST			
18.01.00	Full scale type tests using actual equipment shall be conducted by the Contractor for the equipment mentioned in the subsequent clauses below:			
18.01.01	Full range and full scale performance testing shall be conducted at shop on one number each of the following Fans as per BS 848, Part-1: (a) Booster Fan The performance testing at shop shall be conducted using actual fans			
18.01.02	Leak tightness testing of dampers for each type and size of damper at shop to demonstrate the guaranteed gas tightness efficiency (on flow). The minimum guaranteed gas tightness efficiency of dampers shall not be less than that indicated in clause no. 3.03.08 of this Sub-Section.			
18.02.00	The Bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of Bid Proposal Sheet (BPS) and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer.			
18.03.00	The type tests shall be carried out in presence of the Employer's representative. Contractor shall inform the Employer about his readiness for conducting the type test			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	and issue such notice to the Employer 30 days in advance, along with schedule of the type tests. The Contractor shall obtain the Employer’s approval for the type test procedure before notifying the Employer about his readiness for conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
18.04.00	Irrespective of the requirement of conducting the type tests under this contract, The Contractor shall submit the reports of the type tests carried out for the equipments listed above in clause no. 18.01.00 and These reports should be for the tests conducted on the equipment for the model / type / size / rating to those proposed to be supplied under this contract and the test(s) should have been either be conducted at an test facility/shop/independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.			
18.05.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
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SUB-SECTION-I-M2

AIR CONDITIONING & VENTILATION SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL			
1.01.00	This section of specification covers details of system specifications, detailing the areas to be air conditioned, basis of design, brief description of the system, equipment and services to be furnished by bidder. The Design, Engineering, Supply, Construction, Erection, and Testing & Commissioning of all the equipments & works listed here shall be on the basis of single point responsibility in bidder's scope of work for satisfactory completion of the system in all respect.			
2.00.00	AREAS TO BE AIR CONDITIONED			
2.01.00	The areas to be air-conditioned shall be as follows: a) 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 for FGD Control room building. b) Cassette and Hi-wall Air-conditioners for Other auxiliary control room /control room buildings not listed above but covered in the scope of Bidder.			
3.00.00	AREAS TO BE VENTILATED			
3.01.00	(i) Modular type UAF units of suitable capacity (1x100%) shall be provided for non-air-conditioned area of FGD control room building considering design philosophy for evaporative type ventilation system mentioned in sub section-V (salient design data and sizing), Part-A of technical specification section VI. All non-air-conditioned area of FGD (cable gallery& MCC room shall be positively ventilated and exhaust shall be through gravity damper. (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. (iii) Toilets etc in above building (i) & (ii). Any other area not listed above but covered in the scope of Bidder. (iv) For other miscellaneous areas/ buildings not listed above but covered in the scope of Bidder, mechanical type ventilation system using Supply and/or exhaust air fans/ roof exhausters shall be provided.			
3.02.00	All non-air-conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers as detailed below:			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC															
		<table><tr><th>S.No</th><th>Area</th><th>Type of Ventilation system</th></tr><tr><td>(i)</td><td>General area like pump house, buildings etc</td><td>Combination of Supply air fan & Exhaust air fans</td></tr><tr><td>(ii)</td><td>MCCs and Switchgear room etc</td><td>Supply air fan & Back draft dampers</td></tr><tr><td>(iii)</td><td>Battery rooms & Oil rooms and fumes/odor generates</td><td>Combination of intake louvers & Exhaust air/ roof extractor fans. Motors shall be flame proof.</td></tr><tr><td>(iv)</td><td>Toilet/pantry etc</td><td>Propeller type exhaust air fan</td></tr></table>	S.No	Area	Type of Ventilation system	(i)	General area like pump house, buildings etc	Combination of Supply air fan & Exhaust air fans	(ii)	MCCs and Switchgear room etc	Supply air fan & Back draft dampers	(iii)	Battery rooms & Oil rooms and fumes/odor generates	Combination of intake louvers & Exhaust air/ roof extractor fans. Motors shall be flame proof.	(iv)	Toilet/pantry etc	Propeller type exhaust air fan		
S.No	Area	Type of Ventilation system																	
(i)	General area like pump house, buildings etc	Combination of Supply air fan & Exhaust air fans																	
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(iv)	Toilet/pantry etc	Propeller type exhaust air fan																	
4.00.00	EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM																		
4.01.00	Condensing Unit (Air-Cooled D-X type)																		
	Condensing unit																		
	Type	:	Air cooled scroll type																
	Vibration isolators	:	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.																
	Compressor																		
	Type	:	The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).																
	Type of drive	:	Motor driven, direct or through V-belt.																
	Refrigerant	:	The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.																
	Accessories	:	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.																
	Motor Rating	:	10% more than the power required by the compressor at 50 deg C design ambient temperature.																
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	Capacity : Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated.			
4.02.00	Air Handling Unit (AHU)			
4.02.01	Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs shall be provided.			
4.02.02	The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.			
4.02.03	Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.			
4.02.04	Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.			
4.02.05	All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.			
4.02.06	Centrifugal fan for AHU			
	a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type
	b)	Fan impeller	:	Backward curved blades
	c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.
	d)	Impeller material	:	Carbon steel
	e)	Shaft	:	EN 8 Steel
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	f)	Fan bearings	: Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.	
	g)	Critical speed	: First critical speed of rotating assembly shall be at least 25% above the operating speed.	
	h)	Drive	: Motor driven with removable belt guard. Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.	
	i)	Fans	: For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer.	
4.02.07	Mixing Box:			
	Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU. Further, wherever return air is led back directly to AHU room, no mixing box is required.			
4.02.08	Pan Humidifier:			
	Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.			
4.03.00	HI-WALL SPLIT/CASSETTE AIR-CONDITIONERS			
4.03.01	Hi-wall Split/cassette air conditioners shall in general consist of the following:			
	i)	Casing		
	ii)	Hermetically sealed rotary/scroll Compressor		
	iii)	Condenser and condenser cooling fan		
	iv)	Evaporator along with fan		
	v)	Cooling coil		
	vi)	Filters		
	vii)	Piping, valves, refrigerant strainer, etc.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	viii) Controls, instruments, control panel/starter panels. ix) Vibration isolator pads, etc as required. x) Refrigerant as per manufacturer practice.			
4.03.02	Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type): The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. Unit shall have four way supply air grills on sides and return air grill in center. Each unit shall have high lift drain pump and very low operating sound.			
4.04.00	SPLIT/PACKAGED AIR CONDITIONERS			
4.04.01	Split/package air conditioners shall in general consist of following: I. Casing II. Compressor III. Condenser IV. Evaporator and condenser cooling fan V. Cooling Coil VI. Filters VII. Piping, Valves, refrigerant strainer etc. VIII. Control, instruments, control panel/starter panels. IX. Vibration isolator pads, ducting (if applicable) etc as required.			
5.00.00	EQUIPMENT DESCRIPTION - VENTILATION SYSTEM			
5.01.00	Unitary Air Filtration			
5.01.01	Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellant type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories.			
5.01.02	The housing/ casing of air washer unit shall be double skin construction. Double skin panels shall be made of 22G galvanized sheet on outer side and 20G galvanized sheet inside with 25mm thick polyurethane foam insulation of minimum 38 kg/cub. Mtr. Density in between. Frame work for section shall be joined together with soft rubber gasket in between to make the joints air tight. The entire fan section shall be mounted on rolled formed GSS channel frame work.			
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5.02.02	The bearing shall be self aligning, heavy duly ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.		
5.02.03	Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square.		
5.02.04	Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.		
5.02.05	The first critical speed of the rotating assembly shall be at least 25% above the opening speed.		
5.02.06	The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.		
5.03.0	Roof Ventilators (If applicable)		
5.03.01	The roof extractors shall be “COWL” type.		
5.03.02	Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided.		
5.03.03	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required will be provided.		
5.03.04	The speed of the fan be limited as per limitation given above for axial fans.		
5.03.05	All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.		
5.03.06	The vibration level for fans shall be as per ISO: 14694.		
5.04.00	Centrifugal Pumps		
	a) Type : Horizontal Centrifugal, Axially or radial split type casing pump or end suction, top discharge horizontal centrifugal pump		
	b) Impeller : Closed type		
	c) Material of Construction		
	i) Casing : 2% Ni Cast Iron : IS:210 Gr. FG-260		
	ii) Impeller : Bronze IS:318 Gr-2		
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	iii) Wearing rings	: Bronze	
	iv) Shaft	: SS 316	
	v) Shaft sleeve	: SS 316	
	vi) Lantern ring	: Brass / Bronze	
	vii) Packing	: Asbestos free	
	viii) Base Plate	: Carbon steel as per IS:2062	
	ix) Speed	: Maximum 1500 rpm	
	x) Other requirements	: To refer to Annexure-I titled “Horizontal Pumps” of this sub section.	
5.05.0	Axial Fans		
5.05.01	These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design.		
5.05.02	The fan casing shall be of heavy gauge sheet steel construction.		
5.05.03	Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.		
5.05.04	The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1440 rpm for fan with impeller diameter of above 450 mm and 2800 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed.		
5.05.05	All other accessories like supporting structure etc. as required shall be provided.		
5.05.06	Fans of capacity 1000 m³/hr & lower shall be of propeller exhaust type.		
6.00.00	BALANCE EQUIPMENT SPECIFICATION		
6.01.00	Material of Construction for Piping & Fittings		
	a) Piping for Chilled and Condenser water lines	: Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in Annexure-II	
	b) Refrigerant piping :	: Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).	
	c) Drain piping	: Same as (a) above & galvanized as per IS:4736.	
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	d) Fittings	:	1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5	
6.02.00	VALVES			
6.02.01	Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.			
6.02.02	Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.			
6.02.03	All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.			
6.02.04	Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.			
6.02.05	Manual gear operators be provided for valves of size 200 NB and above.			
6.02.06	All valves shall be supplied with companion flanges, nut, bolts & washers, etc.			
6.02.07	The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.			
6.02.08	Gate valves shall be of Cast Iron body (confirming to IS:210 Gr FG 220/equivalent) for sizes 65 NB and above conforming to fIS :14846. Gun Metal construction for sizes less than 65NB shall be as per IS:778. Butterfly valves shall conform to latest revision of BS:5155 or equivalent standard of required class/rating.			
6.03.00	AIR FILTERS			
6.03.01	Pre Filter 1) Type : Flange / Cassette 2) Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.03.02	expanded metal on exit side or G.I. wire mesh on both sides. 3) Other requirements : (as applicable) a) Suitable aluminium spacers be provided for uniform air flow; b) Casing shall be provided with neoprene sponge rubber sealing. c) Capable of being cleaned by water flushing. d) Density of filter medium shall increase in the direction of air flow in case of metallic filter. e) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost. 4) Efficiency : Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779. 5) Minimum thickness : 50 mm 6) Face Velocity : Not more than 2.5 m/sec. 7) Pressure drop : Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC. 8) Location : a) At the suction of each AHUs b) At the suction of each Fresh air fan Fine Filters (Microvee type) 1) Type : Flange / Cassette 2) Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides. 3) Other requirements : a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.			
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	4)	Efficiency	:	Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779.
	5)	Minimum thickness	:	150 mm or 300 mm.
	6)	Face Velocity	:	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
	7)	Pressure drop	:	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
	8)	Location	:	i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan.
6.04.00	LOW PRESSURE AIR DISTRIBUTION SYSTEM			
6.04.01	Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS :277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS:737). GI Sheets should be galvanized and galvanizing shall be of 275 gms/sq.m. (total coating on both sides) both for site fabricated and factory fabricated ducts.			
6.04.02	Thickness of rectangular ducts shall be as follows:			
	Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)	
	up to 750 mm	0.63 (24 G)	0.80	
	751 to 1500	0.80 (22 G)	1.00	
	1501 to 2250	1.00 (20 G)	1.50	
	2251 & above	1.25 (18 G)	1.80	
6.04.03	Thickness of round ducts shall be as follows:			
	Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)	
	150 to 500	0.63	0.80	
	501 to 750	0.80	1.00	
	751 to 1000	0.80	1.00	
	1001 to 1250	1.00	1.50	
	1251 & above	1.25	1.80	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.04.04	Duct Fabrication and Supports: a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard. b) Ducts for A/C system may be site fabricated or factory fabricated. c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns with provision of necessary auxiliary or special steel members or by hooks or can be provided by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder. Where ever ducts are running outside the building and or at locations where it is not possible to support the ducts from ceiling/floor due to non-availability of the same, the base steel frame/truss work and other auxiliary steel members, hooks, rods, etc. for supporting the duct work shall also be provided by the Bidder. d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass. e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected. f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space. g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air. h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.			
6.04.05	Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS			
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6.04.06	sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position. Factory fabricated ducts : i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA) iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply: a) Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct. b) All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines. c) All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges. d) Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used. v) Factory fabricated ducts shall have the thickness of the sheet as follows: <table><tr><th>Sl.No.</th><th>Size of Duct</th><th>Sheet Thickness</th></tr><tr><td>i)</td><td>upto 750 mm</td><td>0.63 mm</td></tr><tr><td>ii)</td><td>751 mm to 1500 mm</td><td>0.80 mm</td></tr><tr><td>iii)</td><td>1501 mm to 2250 mm</td><td>1.00 mm</td></tr><tr><td>iv)</td><td>2251 mm and above</td><td>1.25 mm</td></tr></table>				Sl.No.	Size of Duct	Sheet Thickness	i)	upto 750 mm	0.63 mm	ii)	751 mm to 1500 mm	0.80 mm	iii)	1501 mm to 2250 mm	1.00 mm	iv)	2251 mm and above	1.25 mm
Sl.No.	Size of Duct	Sheet Thickness																	
i)	upto 750 mm	0.63 mm																	
ii)	751 mm to 1500 mm	0.80 mm																	
iii)	1501 mm to 2250 mm	1.00 mm																	
iv)	2251 mm and above	1.25 mm																	
6.05.00	Diffusers, Grills & Dampers :																		
6.05.01	Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas.																		
6.05.02	Return air diffusers of air-conditioned areas shall be without volume control dampers.																		
6.05.03	The diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The colour of power coating shall be as per the interior décor.																		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
6.05.04	Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.		
6.05.05	All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.		
6.05.06	The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.		
6.05.07	Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.		
6.05.08	Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.		
6.05.09	All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames.		
6.05.10	All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.		
6.06.00	Thermal and Acoustic Insulation		
6.06.01	A) <u>Application with Glass Wool / Rockwool</u> (i) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products / Loid bond 83 or Equivalent) be applied @ 1.5 Kg /Sqm on the surface. (ii) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber / Rockwool) shall be struck to the surface. All the joints shall be sealed with bitumen. (iii) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side or alternatively aluminum foil can be used which can come as lamination over insulation. (iv) Insulation Finish of types specified under shall be provided thereafter.. B) <u>Application with Nitrile Rubber</u> (i) All surfaces to be insulated shall be properly cleaned. (ii) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces. (iii) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within. (iv) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering. C) <u>Application with Polyurethane Foam & Polyisocyanurate Foam</u> i) All surfaces to be insulated shall be cleaned.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
6.06.02	ii) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces. iii) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within. iv) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering. v) Insulation Finish of types specified under shall be provided thereafter.					
	Type of Insulation & Finish					
	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
	1.	Supply & return air duct of AC System	Resin bonded glass wool or	Roll /Slab	50	F-3
			Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.
			or Polyisocyanurate Foam	Slab	30	F-3
	2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
			or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
	3.	AHU pipe drain	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
			or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
4.	AHU condensate pan (insulation	Mineral wool or resin bonded glass wool	Slab	25	As per manufacturer std.	
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	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		if required)				
	5.	Chilled water piping, valves & specialties	Resin bonded Mineral wool or resin bonded glass wool	Pipe section	75	F-1/F-3
			or Rigid Polyurethane Foam	Pipe Section	50	F-3
	6.	Chiller (insulation if required)	----- As per manufacturer std.-----			
	7.	Chilled water pumps	Resin bonded Rockwool wool or resin bonded glass wool	Slab	75	F-1/ F-3
			or Rigid Polyurethane Foam	Slab	50	F-3
	8.	Expansion tank with associated piping	Resin bonded Rockwool wool or resin bonded glass wool	Slab/ Pipe section	75	F-1/ F-3
			or Rigid Polyurethane Foam	Slab	50	F-3
	9.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications
	10.	Exposed air duct	Resin bonded Glass wool/Rockwool	Roll/Slab	50	F-4
			Or Polyisocyanurate	Slab	50	F-4(a)
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6.06.03	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)	
			Foam				
	Specification for insulation shall be as follows: -						
	Insulation Material		Code	Thermal conductivity (w/m/°C)	Density Kg/m ³		
	Resin bonded glass wool		IS:8183	0.049 at 50°C	i) 24 (For Glass wool)		
				0.043 at 50°C	ii) 48 (For Rockwool)		
					iii) 48(For acoustic insulation)		
	Mineral wool pipe section. Min.Gr.2		IS:9842	0.043 at 50°C	144		
	Closed Cell Elastomeric Nitrile Rubber			0.036 at 20°C	40 – 60		
	Polyurethane Foam		IS12436	0.03 at 50 °C	34 ± 2		
Polyisocyanurate Foam		0.03 at 50 °C		34 ± 2			
6.06.04	Note : Insulation used for HVAC application shall be CFC/HCFC free						
	The specification for various finishes shall be as follows						
	a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool) Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound. Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.					
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
		<u>Step-3</u> Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.	
	aa)	Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam) Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent	
	b)	Finish F-2 <u>Step-1</u> Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.	
		<u>Step-2</u> Same as Step-2 of Finish F-1 above.	
		<u>Step-3</u> Same as Step-3 of Finish F-1 above.	
	c)	Finish F-3 <u>Step-1</u> Same as Step-1 of Finish F-2 above	
		<u>Step-2</u> The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.	
	d)	Finish F-4 <u>Step-1</u> Same as Step-1 of Finish F-1 above.	
		<u>Step-2</u> Same as Step-2 of Finish F-1 above.	
		<u>Step-3</u> Same as Step-3 of Finish F-1 above.	
		<u>Step-4</u> Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.	
		<u>Step-5</u> After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface.	
	dd)	Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene) Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress. All sheet joints to be done in a manner to shed water.	
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6.06.05	For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.		
6.06.06	ACOUSTIC INSULATION a) All ducts up to a distance of 5 meters from AHU shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension. b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.		
7.00.00	PLANT CONTROL		
7.01.00	Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control & instrument sections shall also be referred to.		
7.02.00	Control Scheme for Air-Conditioning System		
7.02.01	Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning and ventilation system as per manufacturer's standard practice. Control and monitoring of air conditioning and ventilation system from FGD control system is also acceptable.		
7.03.00	Air Handling Unit a) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification. b) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be. c) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct) d) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility. e) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with Fire Detection System.		
7.05.00	Cassette /Hi-wall Split Air Conditioners Control and interlocks for these type of units shall be as per manufacturer's standard practice.		
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7.06.00	Miscellaneous Control Requirements a) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally. b) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD control system.		
8.00.00	PAINTING:		
8.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.		
8.02.00	The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.		
8.03.00	For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.		
8.04.00	For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied.		
8.05.00	For centrifugal fans - Casing shall have hot dip/ spray galvanization (minimum 60 micron DFT).		
8.06.00	However, for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.		
9.00.00	CODES & STANDARDS		
9.01.00	The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.		
9.02.00	Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Annexure –I GENERAL SPECIFICATION FOR HORIZONTAL PUMPS 1) SCOPE This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps. 2) CODES AND STANDARDS The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards. 3) List of Applicable Standards. IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water IS : 5120 : Technical requirements of roto dynamic special purpose pumps API : 610 : Centrifugal pumps for general refinery service. IS : 5639 : Pumps Handling Chemicals & corrosion liquids IS : 5659 : Pumps for process water HIS : Hydraulic Institute Standards, USA ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection. In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail. 4) DESIGN REQUIREMENTS a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within $\pm 10\%$ of the rated design flow as indicated in data sheets. b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.		
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	Annexure –I			
c)	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.			
d)	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:			
	Speed	Antifriction Bearing	Sleeve Bearing	
	1500 rpm and below	75.0 micron	75.0 micron	
	3000 rpm	50.0 micron	65.0 micron	
	The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.			
e)	The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.			
f)	The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).			
g)	Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.			
h)	The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.			
5)	DESIGN CONSTRUCTION			
a)	Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	Annexure –I b) Pump Casing Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation. c) Impeller Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation. d) Impeller/Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer’s standard practice. e) Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation. f) Shaft Sleeves Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	Annexure –I g) Bearings Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing. h) Stuffing Boxes Stuffing box design should permit replacement of packing without removing any part other than the gland. Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer’s standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection. i) Mechanical Seals Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped. j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply. k) Pump Shaft Motor Shaft Coupling The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	Annexure –I			
l)	Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.			
m)	Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.			
n)	Drive Motor (Prime Mover) The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).			
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ANNEXURE-II

PIPING THICKNESS: Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The thickness as mentioned below are the minimum specified nominal thickness as per IS: 3589. Tolerance as code shall be applicable.

Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)
200 NB	219.1	4.5
250 NB	273	5
300 NB	323.9	5.6
350 NB	355.6	5.6
400 NB	406.4	6.3
450 NB	457	6.3
500 NB	508	6.3
600 NB	610	6.3

SUB-SECTION-I-M3

COMPRESSED AIR SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	COMPRESSED AIR SYSTEM			
1.00.00	SYSTEM DESCRIPTION			
1.01.00	The compressed air system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping network, service air piping network etc.			
1.02.00	Air from air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one common header to be provided to meet the service and instrument air requirement for FGD Plant.			
2.00.00	SCREW AIR COMPRESSORS			
	The minimum requirements of design and construction features of various components of Compressed air system (screw type air compressor, air dryer, air receiver, etc.) are described below.			
2.01.00	CODES AND STANDARDS			
2.01.01	The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727 and CAGI).			
2.01.02	Other International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal.			
2.01.03	The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.			
2.02.00	DESIGN AND CONSTRUCTION			
2.02.01	The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.			
2.02.02	The rotor and shaft shall be of single piece construction, made of forged steel (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.			
2.02.03	The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts.			
2.02.04	Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.			
2.02.05	Lubrication system shall be as per manufacturer standard practices			
2.03.00	Gear Box			
2.03.01	Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	PERFORMANCE REQUIREMENT		
3.01.00	Air Compressors (screw type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as per approved data sheet submitted by the bidder during detailed engineering.		
3.02.00	The power rating of the driver shall be selected such that a minimum margin of 10% is available over the power required to deliver rated capacity against rated pressure.		
3.03.00	As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room.		
4.00.00	INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW)		
4.01.00	Intercoolers, After coolers and Oil coolers shall be of water cooled & shell-and-tube type with water on the tube side. Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.		
4.02.00	Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. However, the instruments or the pneumatic devices requires air temperature less than 45 deg.C., the same shall be achieved at the outlet header.		
4.03.00	Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover.		
4.04.00	Oil Coolers shall be equipped with vent & drain connections on oil and water sides. Oil temperature control valve with manual override feature or bypass construction shall be provided to maintain constant temperature. Vent & drain connections for intercoolers and aftercoolers shall be provided.		
4.05.00	Design pressure shall be 8 Kg/cm2 (g) or based on shut-off head of cooling water pumps.		
4.06.00	The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes.		
4.07.00	Adequately sized safety valves shall be provided for both intercoolers and after coolers.		
4.08.00	Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.		
4.09.00	Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap.		
4.10.00	Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70 / equivalent).Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304.		
4.11.00	For the instrument air compressors offered with "Heat of compression" type air drying plants, the after coolers shall be provided at downstream of Air Drying Plant.		
5.00.00	AIR RECEIVERS		
5.01.00	The design pressure and temperature shall be minimum 10 Kg/cm ² (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.		
5.02.00	Air receivers are to be provided with gasketed inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
5.03.00	Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use.	
5.04.00	Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.	
5.05.00	Each receiver shall be provided with drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves.	
5.06.00	The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.	
6.00.00	INTAKE AIR FILTER AND SILENCER	
6.01.00	Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type.	
6.02.00	The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.	
6.03.00	The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.	
7.00.00	AIR DRYING PLANTS	
7.01.00	One number Air drying plant shall be provided for each air compressor. Drying shall be by adsorption process through a desiccant medium.	
7.02.00	Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type".	
7.03.00	Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss.	
7.04.00	Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in case of "Heat of compression type ADP" and air from blower shall be used for regeneration after heating by electrical heater in case of "Open through type ADP".	
7.05.00	Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.	
7.06.00	In "Open Through" type ADP, for regeneration of desiccant, atmospheric air shall be filtered, heated through an electric heater and passed through the desiccant before exhausted to atmosphere. The reactivated desiccant shall be cooled through same atmospheric air without heater in operation. In case of HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP.	
7.07.00	Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
7.08.00	The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. The pre-filters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves.		
7.09.00	The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element.		
7.10.00	Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.		
7.11.00	The adsorber tower shall be designed with sufficient cross sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.		
7.12.00	The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.		
7.13.00	All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketed manholes/handholes and relief valves.		
7.14.00	Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.		
7.15.00	Adsorption capacity and density to be considered for silica gel shall not be more than 10% and 550 kg/m ³ respectively. In case of activated alumina the same shall be 8% (max) and 900 kg/m ³ (max.) respectively.		
7.16.00	In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period.		
7.17.00	Complete ADP equipment shall preferably be mounted on a skid.		
7.18.00	Required sample connections in piping be provided for sampling of air at desired locations.		
7.19.00	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.		
7.20.00	The material of Construction for various components of ADP shall be as as per manufacturer's proven standard.		
8.00.00	HOC dryers of single rotating drum type design using packed dessicant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design.		
8.00.00	INTERCONNECTING PIPING, FITTING AND VALVES The interconnecting piping & valves within compressor house for compressed air & cooling water etc shall be designed in line with the specification furnished in subsection titled "Low Pressure Piping" of Part-B of this Technical Specification.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	CONTROL PHILOSOPHY			
9.01.00	GENERAL			
9.01.01	The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage.			
9.01.02	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.			
9.01.03	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.			
9.01.04	All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.			
9.01.05	An electrically operated automatic valve shall be provided on cooling water supply line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.			
9.01.06	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels. (a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP			
9.01.07	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.			
9.01.08	Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.			
9.02.00	Screw Compressor			
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			
9.02.02	In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve.			
9.02.03	In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped			
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	in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.			
9.02.04	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.			
9.02.05	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:-			
	(a)	"Air temperature high" at inlet to last stage	Alarm & trip	
	(b)	"Low lube oil pressure"	Alarm & trip	
	(c)	"High Lube oil supply temperature"	Alarm & trip	
	(d)	"High oil filter differential pressure"	Alarm	
	(e)	"Low lube oil level in lube oil sump"	Alarm	
	(f)	"High inlet air filter differential pressure"	Alarm & trip	
	(g)	"Low cooling water flow to air compressor"	Alarm	
9.03.00	Air Drying Plant			
9.03.01	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over.			
9.03.02	Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.			
9.02.03	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.			
9.02.04	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.			
10.00.00	PAINTING			
	All the equipments shall be protected against external corrosion by providing suitable painting.			
	The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting.			
	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure.			
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SUB-SECTION-I-M4

FIRE DETECTION & PROTECTION SYSTEM

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	FIRE PROTECTION AND DETECTION SYSTEM			
1.00.00	GENERAL DESCRIPTION			
1.01.00	A comprehensive Fire Detection and Protection System covering all the areas of the power plant including Employer's facilities/ system /buildings (if applicable) is included in the scope of the Contract.			
1.02.00	The complete Fire Detection and Protection Systems shall be as per the guidelines/ codes/ standards / rules of TAC/ NFPA / IS: 3034 / OISD etc. and all the systems, equipments and installation shall be got approved from TAC accredited professional(s)-India.			
2.00.00	HYDRANT SYSTEM			
	Hydrant system shall consist of piping, hydrant valves, landing valve, water monitors, hoses, branch pipes, nozzle, hose boxes, etc.			
2.01.00	Areas to be Covered			
	Complete FGD area and other auxiliary buildings / areas under the scope of the Bidder.			
3.00.00	HVW AND MVW SPRAY SYSTEM			
3.01.00	General			
	It shall consists of water mains network, deluge valves, isolation valves, Y type strainers, spray nozzles/ projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc.			
3.02.00	Areas to be covered by HVW Spray System			
	i) All transformers For FGD System of rating 10MVA & above OR having oil capacity above 2000Ltrs & located with-in plant boundary.			
3.03.00	Areas to be covered under MVW Spray System			
	i) All cable galleries/ cable vault/ cable spreader room in Bidder scope of work under FGD System.			
4.00.00	FIRE EXTINGUISHERS AND FIRE STATION EQUIPMENTS			
4.01.00	Fire Extinguishers			
	As indicated in Bidder's Scope, Part-A.			
5.00.00	FIRE DETECTION, ALARM AND CONTROL SYSTEM			
5.01.00	Codes and Standards			
	a. The design, manufacture, testing, performance, etc. of the various components of the analog addressable Fire Detection and Alarm System shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.			
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5.02.00	b. Unless otherwise specified, the Fire Detection and Alarm System and the components shall conform to the latest applicable Indian or IEC Standards. Equipment complying with any other authoritative National Standards such as British, USA, VDE, etc. will also be considered, provided the parameters specified are equivalent or better than the corresponding IS. c. The Contractor shall be solely responsible for obtaining the required approval and clearance for the different components and systems of the Fire Detection and Alarm System from the following authorities, as applicable: - Department of Atomic Energy (Certification of safety from Radioactivity). - Central Building Research Institute, Roorkee. - Central Mining Research Station, Dhanbad. - Local Fire Authorities. d. The equipment and the system shall be of types approved by any of the following bodies, as applicable: - Loss Prevention Council, (LPC), U.K. - National Fire Protection Association, (NFPA), USA - Under-writers laboratories, (UL), USA - Factory mutual(FM) Areas to be covered under Fire detection and alarm System a) Multisensor type detection system (Above and below the false ceiling or below the false flooring as the case may be) - All switchgear / MCC/battery rooms of FGD control room building, various auxiliary buildings (if applicable), etc. - Cable galleries of FGD control room building protected by MVW spray system. Further, multisensory detectors shall also be provided inside all cubicles/panels of control room, control equipment room and UPS / Battery charger areas. - Above and Below false ceiling areas of all air-conditioned rooms of FGD control room building, various control rooms of auxiliaries as defined in Sl. No. (i) above. b) Linear heat sensing cable detection system Gypsum and lime conveyor of FGD system and Cable Galleries. c) Quartzoid bulb heat detection system Equipments protected by HVW spray system.
5.03.00	General requirements for all types of Detectors 5.03.01 Detectors shall be housed or mounted in suitable enclosure in such a way that their performance is in no way affected. Special maintenance procedures if any required for the satisfactory operation of the detectors shall be clearly stated in the bid. 5.03.02 Necessary mounting accessories shall be provided for all the detectors.
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5.03.03	In case the detectors are offered with their output (on sensing a fire) in the form of an electrical contact, it shall be noted that the contact shall be 'NC' type such that under fire conditions, this contact will open to initiate the fire alarm system.	
5.03.04	Detectors shall preferably be designed as plug-in units, which fit into various bases according to place and type of mounting. This would also enable interchangeability.	
5.03.05	Detectors shall be provided with the necessary compression type cable terminating glands for the incoming cables of flameproof type or PVC/metallic flexible/rigid conduits.	
5.03.06	Depending upon the environmental conditions in which detectors are installed, chlorinated rubber based or epoxy or equivalent paint shall be used for finishing the surface of the enclosure.	
5.03.07	The coverage or the zone of protection afforded by the detector and recommended height of mounting shall be furnished by the Bidder. The bidder shall furnish the test certificate in support of this.	
5.03.08	Any metal parts used for detector construction shall be inherently resistant to corrosion or shall be plated or otherwise suitably treated to afford protection against corrosion. The plating or treatment shall in no way affect the detector performance.	
5.03.09	Any plastic material or any sealing compound used in the detector shall be such as it will not deform or fail under the maximum temperature to be expected.	
5.03.10	No detector shall contain any moving parts subject to wear and tear and must be able to operate afresh after each alarm release, without its exchange or adjustment.	
5.03.11	The detector shall be located where the largest combustion gas concentration can be expected.	
5.03.12	Adequate compensation and considerations shall be made for effects for wind velocities such as air-conditioning system and exhaust fans where dilution of particles of combustion is greater.	
5.03.13	The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air-conditioning shall be avoided for detector location.	
5.03.14	The detectors shall not be affected by temperature, humidity; air flow or by drift failures and shall not give any false alarm due to above.	
5.03.15	The detectors shall not be sensitive to vibrations. Any special mounting arrangements required to counteract vibration shall be included in the contractor scope.	
5.03.16	The quantity of multi- sensor detectors in each zone shall be based on the coverage factor of 25-sq. meter per detector. However the actual quantity of detectors required, taking into consideration obstructions due to floor beams, ventilation, doors, windows etc., shall be worked out and supplied (based on the actual layout) and installed by the contractor.	
5.03.17	The detectors shall not give false alarm due to high humidity, temperature, and velocity of air in the surroundings and static electricity conditions.	
5.03.18	Process actuated switch devices such as pressure switches, flow switches, level switches, etc. shall be provided with suitable individual addressable interface (local or remote) units or modules so that these devices are addressable from the panel.	
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5.05.00	Linear Heat Sensor Cables Application Detection of Stationary fire Type Digital Operating voltage 24 V DC Approval FM/UL Conductor material Steel Insulation Heat sensitive polymer Outer Sheath Black or colored PVC or flouropolymer suitable for the application environment Installation features for LHSC 1. Mounting arrangement will be provided as per proven practice. 2. Linear heat sensing cable detector shall run in a zigzag fashion (with an included angle of 90 deg) on each top cable tray, bottom tray and every alternate intermediate trays of each section of cable tray without undue sagging and interfering the normal operations. All supporting materials for mounting of LHSC shall be provided by the bidder.			
5.06.00	Addressable Analog Intelligent Detectors In addition to the features specified under the item General requirements for all types of Detectors, the Addressable Analog Intelligent Detectors shall be provided with the following features: a) Detectors not specifically listed for sensitivity testing from the control panel are not acceptable due to the expense involved with manual testing as required by NFPA 72E. b) The detector shall be suitable for two-wire operation and two-way communication on the intelligent analog signaling circuit. c) The detector shall display a steady LED when in the Alarm State. The LED shall flash when in stand by or normal mode. d) Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as per NFPA-72. e) Address and sensitivity assignments shall be set preferably electronically. However, dip switches / rotary switches for the same are acceptable. The detectors shall be assigned a sensitivity level based on environment, time of day or any programmable function as required by the system user, and shall respond at that level whether in the “on line” or “default” mode. f) The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	g) The detectors furnished shall be listed for use in environments as covered by Factory Mutual and UL and shall be installed according to the requirements of NFPA 72E for open area coverage.		
5.07.00	Multi sensor Detectors		
5.07.01	Multi sensor detectors shall incorporate a heat detection element and a photoelectric detection element. Both the elements shall be incorporated in a single unit. Both the elements shall be operative at all times and the fire signal shall be available from any or both elements combined together.		
5.07.02	The detectors shall be sensitive to very low smoke densities of the order of say 0.05 g/m ³ . Also it shall be possible to adjust this sensitivity on a step less basis over a range so that the optimum sensitivity could be selected at site to suit the conditions of installations. The coverage area of the smoke detection under standard NFPA test conditions shall not be less than 80-90m ² .		
5.07.03	The detectors shall be complete with a mounting base that includes a terminal box into which the detector can be plugged in. Terminals for looping of the cables shall be provided.		
5.07.04	All detectors shall be provided with built-in response and indicating lamps which shall give local visual indication, when it has operated in dense smoke conditions. The failure of lamp shall not prevent the function of detector.		
5.07.05	In areas such as false ceiling where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.		
5.07.06	It shall be possible to replace any type of detector head by a different type detector without requiring change in cabling/panel wiring and condition of the zone, originally covered by the detector.		
5.08.00	System Configuration		
5.08.01	The Addressable Fire Alarm panel shall be able to communicate with repeater annunciation panel located at different places. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location.		
5.08.02	At least one spare loop shall be provided in each of the addressable type fire alarm panel located in FGD control equipment room with complete loop card and all other accessories so that Employer can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by Employer in future.		
5.08.03	FGD Fire alarm system shall be provided with necessary interface hardware and software for communicating fire alarms from this fire alarm panel to the main plant fire alarm control panel through potential free contacts.		
5.09.00	Analog Addressable Fire Detection and Alarm System		
5.09.01	General Requirements		
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5.09.02	This specification in general covers the functional requirements, and general design aspects of Microprocessor based, Analog Addressable Fire Detection Alarm / Annunciation and Control System.		
5.09.03	The following description intends to describe only the brief hardware and functional requirements, scope of hardware requirements etc. but the actual configuration of the system shall be in line with the prevalent normal practices in the industry and shall conform to latest product range of selected manufacturer. The fire detection and control system offered shall be complete in all respects for the safe and reliable operation of the entire system. Any additional hardware/software than those mentioned herein required to make the system complete shall be included in the scope of the Bidder.		
5.09.04	All the system and its equipment specifically detectors, interface modules, panels, power supply, battery chargers etc. shall be furnished from a single source and the same shall be new and latest state of the art products of manufacturer engaged in the manufacture of Integrated Microprocessor based Analog Addressable Fire Detection and Alarm System.		
5.09.05	All equipments such as detectors, panels etc shall be approved and listed by UL/FM/LPCB/VDS.		
5.09.06	All types of smoke detectors shall be of analogue addressable type. Conventional detectors with interface modules are not acceptable. Each zone of LHSC detector and each IR detector shall be provided with interface module.		
5.09.07	All the fire detection systems, process actuated switch devices such as pressure/flow/temperature switches and relays of control functions shall be hooked up with the analogue addressable fire detection and alarm system. Required addressable interface units shall be provided for various switch devices by the bidder to make them addressable.		
5.09.08	The wiring shall be of class-A as per NFPA-72.		
5.09.09	Bidder shall provide isolators at the start & end of the loop.		
5.09.10	The complete system shall include, but not be limited to the following : a) Master system CPU. b) Analog Addressable Fire Detection and Alarm System panels including alarm modules, system supervisory control modules, auxiliary output control modules etc. c) Power supplies, batteries and battery chargers. d) Analog addressable type smoke detectors. e) Non addressable type conventional detectors (Linear heat sensing cable detector/ infra red type heat detector) and switching devices each with its own addressable interface modules. f) Software and hardware as required for complete operation of the system. g) Complete Wiring/cabling including its conduits/trays/fixtures etc. i) The fire alarm control panel shall function as a communication interface between central processing unit and sensors. This panel shall have facility to process the		
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	input signal and to control all the input data received from initiating and indicating devices. j) Fire alarm control panel shall have filters to ignore false alarm and increase sensitivity to real fire from sensors. The sensitivity of each detector should be automatically raised if detectors are gradually polluted due to dust and dirt entering inside the detector. If detectors are more polluted the control panel shall give a warning. The trouble report shall indicate the location of device requiring service. k) Fire alarm control panel shall have printer to print out the alarm/ trouble occurrences. l) The CPU shall serve as the systems central processor. Software shall be designed especially for fire alarm annunciation system applications and shall monitor status of processing alarms according to priorities, controlling/processing communications and synchronizing all system activities. n) The system shall be able to recognize and indicate an alarm condition in a degrade mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels. o) All devices shall be individually identifiable for its type, its zone location, alarm set value, alarm and trouble indication by an unique alpha numerical label. p) The software logic modules and system database shall be programmable using a MS - Windows compatible program (latest version) on PC at site and required hardware shall be included in scope of supply. The system software programme shall be password protected and shall include full upload and download capability and during program upload or download through the PC, the capability of alarm reporting shall be retained. The software shall be downloaded to a PC for editing. The software shall enable Employer to add the spare loop provided in the fire alarm panels or addition of additional devices/detectors in any of the fire alarm panel. q) The system shall support the use of Color Graphic display terminal for the display of information in an appropriate format. r) The system shall include software for system data base, historical event log, logic, and operating system. The system shall require no manual input to initialise in the event of a complete power down condition. It shall return to an on line state as an operating system performing all programmed functions upon power restoration. s) Activation of any fire alarm initiating device shall display (LCD alpha numeric display) message in describing the device originating the alarm condition at the Central monitoring station, at alarm panel, simultaneously at the repeater annunciation panel and shall initiate the associated protection systems & other related control functions. Similarly activation of any supervisory circuit, (supervised valve closure, air pressure abnormal, fire pump trouble, water pressure low, etc.) or receipt of trouble report (primary power loss, open or grounded initiating or signaling circuit wiring, battery disconnect etc) shall display at the fire alarm control panel the origin of supervisory condition or origin of trouble condition as the case may be. It shall also record the occurrence of the event, the time of occurrence and the device initiating the same. t) System configuration shall be menu driven and capable of being operated by, a person with no previous computer programming experience.			
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	detectors made available in the panel shall be adjustable from the panel. iv. The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm. v. Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding. vi. The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels. vii. The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall eligible employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel. viii. The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format. ix. The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration. x. Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the system database off site after down loading from the panel. xi. All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel. xii. In an alarm or trouble condition the following shall occur on the monitoring station: 1. Sound an audible. 2. Write details of the actuation to a system log file on the PC. 3. Print the details of the actuation to the system printer. 4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.
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	v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either over-sensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning. a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed. When the full data history is active all devices shall be checked and any active alarms displayed. b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state. c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message shall be displayed when the detector reaches the limits of adjustment due to these contaminate. d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference. vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen. 5.13.00 Power Supply for Fire Alarm Panels & Repeater Alarm Panel 5.13.01 One set of 24V DC redundant power supply system comprising of 2 x 100% chargers and 1 x 100% batteries shall be provided for fire alarm panel and repeater alarm panel. The batteries for fire alarm system shall be sealed maintenance free lead acid type. The battery backup for each fire alarm panel and repeater alarm panel shall be 24 hours and 30 minutes (in alarm conditions). At least 25% of the devices shall be considered to be active in alarm conditions. Each of the redundant chargers shall be sized to meet connected load requirements and keep the connected batteries full charged (Float Mode). Furthermore, the charger shall be sized to enable the boost charge of a fully discharged battery in 10 hours while feeding the load. 5.13.02 The batteries shall be sized as per relevant IEEE standard. For battery sizing calculation, an aging factor of 0.8, a temperature correction factor (based on temperature of 4 deg. C), voltage drop of 2V in cables. Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering.
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- 5.13.03 The battery chargers and batteries shall be placed at a suitable location inside the fire alarm panel with partitions.
- 5.13.04 The detailed specification related to power supply system of fire detection & protection system shall be as specified in other sections of the technical specification.
- 5.14.00 **Control & Instrumentation requirements**
- 5.14.01 Not Used.
- 5.14.02 Not Used.
- 5.14.03 The specification related to Basic design criteria, Measuring Instruments, Process connection & piping, Control panels, Type test requirements etc shall be as specified in other sections of the technical specification.
- 5.15.00 **Cabling for fire alarm system**

All instrumentation cables twisted & shielded, FRLS PVC insulated and sheathed data highway / fibre optical cables, short term fire proof cables including prefabricated cables (with plug-in connectors) etc shall be provided by Contractor.

The contractor shall follow the cable philosophy as below:

Application		Type of cable
From	To	
PLC cabinets	PC, Printers etc.	As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is >300 M & coaxial cable if length <300 M
Detectors (including detectors mounted inside panels) / Any loop device	Detector (including detectors mounted inside panels) / Isolator/ Interface unit	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.
Detectors (including detectors mounted inside panels) / Isolator / Interface Unit	JB	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.
JB	Fire alarm Panel	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.

Notes:

- 10% spare pair shall be provided for all cables having more than four pairs.
- Type "S" cable shall be multicore control cable having overall shielding & specification similar to instrumentation cable except insulation thickness and voltage grade which shall be 1100 V. Type "S" cable shall also satisfy requirements of Article 760 of NFPA 70.
- Over and above, contractor shall provide all the cables so as to complete the system.

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	4. Cable size of 2 core 1.5 sq.mm shall be used for loop wiring in-case of both control cable and short term fire proof cable. 5. Cable size of 2 core 2.5 sq.mm shall be used to provide power supply to various devices in the loop in-case of both control cable and short term fire proof cable. 6. The detailed specification of instrumentation cables and optical fiber cable shall be as specified in other sections of the technical specification. 7. Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top. 8. Detector cable within the building shall be either unarmoured & laid through galvanized iron (GI) conduits or armoured cables, as per the standard and proven practice of the manufacturer.
5.16.00	Detection System for Conveyors i) Linear Heat Sensor Cables: a) The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/supplier. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house. b) The detection zone/loop divisions of LHSC system shall match with the MVW spray system. c) The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel. d) Type: Digital, Operating Voltage: 24V DC, Conductor Material: Steel, Approval: FM/UL
5.17.00	Detection System of Cable Galleries i) In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from Multisensor detection system. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously. ii) LHSC detector shall run in a zig-zag fashion (with an included angle of minimum 90° atleast) in each of the top tray, bottom tray and in every alternate trays. The mounting arrangement of LHSC detector shall be as per manufacturer's standard practice. iii) The detection zone/ loop divisions shall match with MVW spray zones.
5.18.00	Multisensor Detection System i) Upon detection of fire, multisensor detector shall be annunciated in the respective panels and shall activate a local hooter/sounder in the areas where fire is activated and this fire signal shall be employed to initiate the fire extinguishing system of that area such as automatic MVW spray system of cable galleries, fire extinguishing system of Control rooms/Control Equipment Rooms. ii) Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and MVW spray system of cable galleries.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART-B SUB-SECTION-I-M4 FIRE DETECTION & PROTECTION SYSTEM Page 13 of 17

CLAUSE NO.	TECHNICAL REQUIREMENTS
6.00.00 6.01.00	iii) Multisensor detector shall be provided for return air ducts of main plant, which shall consist of intake probe, detector housing, and exhaust pipe etc. The detector shall be mounted outside the duct. iv) The design coverage area for detectors (to be considered) shall not exceed 25 Sq.M. for each detector. PIPING AND VALVES General Data for Pipes etc. i) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) & as per IS:3589 Gr 410 (above 200 NB) or Equivalent for pipes normally filled with water. ii) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) & as per IS:3589 Gr.410 (above 200 NB) or Equivalent and galvanised as per IS:4736 for pipes normally empty and periodically charged with water and foam system application. iii) Pipe protection shall be as follows : To prevent soil corrosion buried pipes / pipes in trench shall be properly lagged with corrosion protective tapes of coal tar type as per IS:15337 or AWWA C 203. The total thickness of protective tapes to be applied on buried pipes / pipes in trench shall be 4.0mm. This can be achieved by using 4.0mm thick tape in single layer or 2.0mm thick tape in double layer. iv) Pipe thickness: a) For Pipe sizes upto 150 NB and above: As per IS:1239 Part-I medium grade. b) For Pipe sizes 200 NB and above refer Annexure-I. v) All valves shall be as per applicable IS/BS codes & approved by TAC for specific fire protection system and shall be provided with locking arrangement (with locks) in open or close condition. Further, all gate/butterfly valves of size 200 mm & above shall be provided with spur gear reduction unit. vi) All the flanges and counter flanges shall conform to ANSI B 16.5 CI 150. vii) Strainer Body as per IS:2062 (tested). viii) Pipe Fittings 1) The material shall conform to ASTM A 234 Gr WPB or ASTM A 105 or equivalent and dimensional standard conforming to ANSI B 16.11 (socket & threaded type), ANSI B 16.9 (for butt welded fittings) and ANSI B 16.5 (for flanges and flanged fittings) as the case may be. Further, galvanised malleable cast iron fittings as per IS:1879 in Cast iron fitting as per BS-1641 are also acceptable. 2) Grooved couplings : Vendor may also use mechanical grooved couplings type fittings in GI pipe lines for HVW / MVW spray system. All materials and products shall be either Underwriters Laboratories (UL) Listed or Factory Mutual (FM) Approved and installed in accordance with NFPA Standard 13 / equivalent Standard. 3) The fittings shall be galvanised as per IS : 4736 for galvanised pipe application. In case of branching connections from GI mains for spray piping network, socket may be welded for more than two pipe reduction instead of standard tees.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART-B SUB-SECTION-I-M4 FIRE DETECTION & PROTECTION SYSTEM Page 14 of 17

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC									
	4) Fabricated fittings shall not acceptable up to pipe size to 300 NB. For sizes 350 NB and above, fittings may be fabricated as per BS:2633/BS:534. ix) Welding of galvanised iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by Employer. After, welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.												
7.00.00	PAINTING												
7.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.												
7.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.												
7.04.00	All Steel Surfaces (external) exposed to atmosphere (outdoor installation)												
	(i) Surface Preparation : The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc. (ii) Painting: One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.												
7.05.00	All Steel Surfaces (external) inside the building (indoor installation)												
	(i) Surface Preparation : The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc. (ii) Painting: One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.												
7.06.00	Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. Painting of all equipments /.components of FDPS package shall be as per manufacturer's standard practice or as detailed below whichever is superior in quality. <table><tr><th>Environment</th><th>Paint scheme</th><th>Total DFT</th></tr><tr><td>Normal / Mild Corrosive Environment</td><td>Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)</td><td>Min 125 microns</td></tr><tr><td>Corrosive Environment (as in coastal areas)</td><td>Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)</td><td>Min 200 microns</td></tr></table>				Environment	Paint scheme	Total DFT	Normal / Mild Corrosive Environment	Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)	Min 125 microns	Corrosive Environment (as in coastal areas)	Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)	Min 200 microns
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PIPING THICKNESS:

Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below.

Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)
200 NB	219.1	6.3
250 NB	273	6.3
300 NB	323.9	7.1
350 NB	355.6	8.0
400 NB	406.4	8.0
450 NB	457	8.0
500 NB	508	8.0
600 NB	610	8.0

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	Annexure-II		
	Technical Data:		
	1. Hydrant Valve	Oblique female type as per IS:5290	
		MOC: Body/bonnet/stop valve/valve seat/trim : SS304/SS316	
	2. Water monitor	As per IS:8442 Type-I, Size: 75mm, Nozzle dia: 38mm	
		MOC: Water barrel/reducer/elbow: CS (seamless)/SS Nozzle: Copper alloy / SS confirm in to IS:3444	
	3. Water branch pipe & nozzle	As per IS:903 / IS:2871	
		MOC: Branch pipe: SS316 (Gr 4 of IS:3444) (both ends) Nozzle : SS316 (Gr 4 of IS:3444), Size: min 16mm & max 25mm	
	4. Water line Gate / Sluice Valve	- Design Code: a) IS:14846 or BS:5150 (for valves coming inside fire water pump house) b) BS:5150 (for valves at other locations) - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) -Working Pr. :12Kg/cm2	
		MOC: Body/bonnet/Yoke/Wedge : CI to IS:210 FG-200 Spindle: SS to ASTM-A-276 type 410	
	5. Butterfly Valve	Design Code: Double flanged or lugged wafer type of low leakage rate confirming to BS:EN:593/API-609/AWWA C-504 Pressure class: PN 16	
		MOC: Body & Disc : Cast Iron, Shaft : SS 410 / SS 420 Seat Rings : EPDM	
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SUB-SECTION-I-M5

EQUIPMENT COOLING WATER SYSTEM

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	EQUIPMENT COOLING WATER (ECW) SYSTEM 1.00.00 BRIEF DESCRIPTION OF SYSTEM 1.01.00 The Equipment Cooling Water System shall be provided for Flue Gas Desulphurization system Auxiliaries as described. 1.02.00 The Equipment cooling water system shall be separate for each Stages of FGUTPP-I, Farakka-I, Faraka-II, Faraka-III, Kahalgaon-I, Kahalgaon-II, Singrauli-I, Singrali-II & Rihand-I. The ECW system shall be common for FGUTPP-II & III. The cooling system for Flue Gas Desulphurization system Auxiliaries shall be of closed circuit type with demineralized (DM) water in the primary circuit. The secondary cold cooling water to be used as process water shall be tapped either from CW blowdown or Clarified water tank or Service water tank for different projects. Also water for Gypsum washing and make up for AC & Ventilation system shall be tapped either from FGD clarified water tank or HVAC header near to FGD area. Details of the tapping for individual project for each type of water is mentioned in Terminal points & Exclusion chapter of the technical specification. Part of the tapped clarified water is also being used for Gypsum washing. Hence all materials of construction used in primary and secondary side of the equipment cooling water system should be suitable for the water quality. The scheme shall be as per relevant tender drawing listed elsewhere in the specification. The DM cooling water pumps shall be provided as indicated in the relevant tender drawing. 1.03.00 Quality of water (a) Primary circuit - Demineralized (DM) water (b) Secondary circuit - Condenser cooling water/ Clarified water 1.04.00 The pH of DM water in the closed loop shall be continuously monitored and controlled at around 9.5. The control shall be achieved by dosing sodium hydroxide in DM water overhead tank and DM water header. The dosing shall be done manually by operating dosing valve. 2.00.00 SYSTEM DESIGN 2.01.00 The ECW system design for Flue Gas Desulphurization system Auxiliaries shall be as follows: A centralized/combined ECW system is envisaged for all FGD system auxiliaries. In the primary circuit, Demineralized cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE) for cooling of the FGD system auxiliaries. The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to the individual Flue Gas Desulphurization system Auxiliaries coolers. No booster pumping system shall be provided in the primary system. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit. 2.02.00 The secondary circulating water system shall receive water through a tapping either from CW blow down or clarified water tank or service water tank for different stages of different projects as mentioned in terminal & exclusion chapter. This water will be further pressurized by a set of auxiliary (secondary) cooling water pumps and fed through the plate type heat exchangers and the discharge secondary water from PHEs shall be used as process water for FGD system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 1 OF 15	

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM 		
	The Gypsum Wash Water (Clarified Water) shall be supplied either through clarified water tank or service water tank or tapping from HVAC header or AC cooling storage tank for different stages of different projects as mentioned in terminal & exclusion chapter.		
2.03.00	For the primary cooling circuit, an overhead tank of minimum (normal) capacity of 5 Cu.M shall be provided by the bidder. Outlet of this tank shall be connected to the closed circuit return header. The normal capacity of the tank shall be at 60% of the tank height to serve.		
2.04.00	Frame of each plate type heat exchanger shall have about 25% extra capacity i.e. the frame shall be able to accommodate about 25% extra plates.		
2.05.00	Make up to the closed loop primary circuit shall be taken from the DM water transfer pumps located near DM water storage tank and emergency make up from the discharge of condensate transfer pumps. The make-up would be given to overhead storage tank separately.		
2.06.00	Required orifices shall be provided in the primary and secondary circuit of Equipment Cooling Water system for balancing of pressure.		
3.00.00	CONSTRUCTION FEATURES		
3.01.00	Pumps and Heat (PHE) Exchangers		
3.01.01	The general design and construction features of various pumps of the Equipment Cooling Water System shall be as per the Annexure titled “GENERAL SPECIFICATION FOR HORIZONTAL PUMPS” enclosed with this sub-section.		
3.01.02	Specific features of various pumps and plate type heat exchangers of ECW system shall be as follows :- A) Pumps (ECW System) i) Type : Horizontal Centrifugal type ii) Casing : Axially split type. iii) Impeller type : Closed/Semi open iv) Speed : 1500 rpm (max.) v) Drive transmission : Direct vi) Seal : Mechanical seal for primary water pumps and Self water/gland for secondary side vii) Lubrication : Oil/Grease/Self liquid. viii) Coupling : Spacer type. ix) Drain plug, vent, priming connection, : Required. x) Coupling guard, lifting lugs, Anchor bolt etc : Required		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 2 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		एनटीपीसी NTPC	
	xi) Operating range : 40% to 120% of rated flow xii) Pump characteristic : Non-overloading type & stable xiii) Parallel operation : Required. xiv) service duty : Continuous xv) <u>Material of Construction:</u> Primary Side DM Cooling Water Pumps Secondary side Auxiliary Cooling Water Pumps/ Clarified water pumps a) Casing ASTM-A-351 CF8M 2.5% Ni Cl to IS 210 GR FG-260 b) Impeller ASTM-A-351 CF8M Bronze to IS 318 Gr. I/II or SS – 316 / CF8M c) Impeller Wearing Rings SS-316 High leaded bronze to IS-318 Gr.V / SS -316 in case of SS Impeller. d) Casing wearing rings -----DO ----- -----DO ----- e) Shaft SS-316 SS-316 f) Shaft Sleeve SS-316 SS-316 g) Gland ----- 2.5% Ni Cl to IS 210 GR FG-260 h) Lantern Ring SS-316 Bronze i) Gland packing ----- Teflon Impregnated /Manufacturer's standard (Non-Asbestos type) i) Mechanical Seal SiC/TiC ----- j) Base plate ----- MS fabricated - IS:2062 ----- k) Stuffing Box ----- 2.5% Ni Cl to IS 210 GR – FG-260 l) All fasteners Stainless steel Stainless steel B) Plate type Heat Exchangers - Design Parameters (i) Type : Plate type, single pass (ii) Design pressure : Maximum expected pressure to which PHE may be subjected plus 5% additional margin. Maximum expected pressure shall be based on the shut-off head of pumps (either the secondary or primary side)			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 3 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			एनटीपीसी NTPC
	whichever is maximum) plus the suction pressure of the pumps. Material of Construction (i) Heat transfer plate : SS-AISI-316 (ii) Compression / Fixed plates : IS:2062 (iii) Movable pressure plate : IS-2062 (iv) Guide rail : IS-2062 with stainless steel cladding (v) Support Beam/Column : IS 2062 (vi) Plate gasket : Nitrile Rubber (vii) Nozzle : Carbon steel (viii) Flanges : Carbon steel (ix) Nozzle flange Gasket : 3 mm wire inserted Red Rubber. (x) Nozzle flange Bolts/ Nuts : SA 193 B7/SA 194 2 H. (xi) Name plate : AISI-316 (xii) Tightening Rods : IS-1367 or equivalent Other Features: (i) Double sealing arrangement should be provided at outer edge and around ports to avoid intermixing of fluids. The inter-space should be vented to atmosphere. (ii) Plate thickness should be adequate to withstand all operating conditions but not less than 0.6 mm. (iii) Frame of exchanger should be designed so that 25% additional plates can be added in future. (iv) Flanges shall be per ANSI B 16.5 for equivalent. (v) Thickness of pressure and frame plates as per ASME sec. VIII Div. I. (vi) Minimum corrosion allowance for heat exchanger parts shall be 1.6 mm. (vii) After pressing all the plates shall be tested by light box/vacuum/air chamber test as per manufacturers' standard practice. (viii) The corrosion allowance for the heat exchanger plate such as pressure parts (support plates), nozzles, sliding channels and frame shall be 1.6mm (minimum).			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 4 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		एनटीपीसी NTPC																																					
3.02.00	Piping, Valves /Tanks: Construction features of Piping, Valves and tanks shall be as per the sub-section titled "Low Pressure Piping" of this Technical specification																																							
3.03.00	Self-cleaning strainer: (a) To prevent fouling on the secondary cooling waterside of the PHE, self-cleaning type filters, (2 X 100%) shall be provided by the bidder on the secondary cooling water inlet header to the PHE. (b) Body of filter shall conform to IS:210Gr. FG260 or ASTM-A-515 Gr. 75/IS: 2062 and internally painted with epoxy. (c) Strainer element shall be constructed of perforated stainless steel plate linked with stainless steel (SS316) screen for fresh water and SS316L grade SS screen for sea water. (d) The mesh size shall be selected on the basis of average clearance between the plates of the plate heat exchanger.																																							
3.04.00	Construction features of ECW overhead tank <table><tr><th>Sl. No.</th><th>Description</th><th>Tech. Particulars</th></tr><tr><td>I.</td><td>Quantity</td><td>: One (1)</td></tr><tr><td>II.</td><td>Capacity</td><td>: 5 Cu.M (Minimum.)</td></tr><tr><td>III.</td><td>Type</td><td>: Horizontal Dished ends</td></tr><tr><td>IV.</td><td>Design Pressure</td><td>: Atmospheric</td></tr><tr><td>V.</td><td>Design Standard</td><td>: ASME Boiler and Pressure Vessel code Section-VIII/IS:2825 (Class 3)</td></tr><tr><td>VI.</td><td>Material of Construction</td><td>: Plates to IS:2062/ ASTM A36.Minimum shell thickness shall be 6mm.</td></tr><tr><td>VII.</td><td>ACCESSORIES</td><td></td></tr><tr><td>(a)</td><td>Vent, overflow and drain</td><td>: Required (Overflow drain to be taken upto 'O' M plant drain)</td></tr><tr><td>(b)</td><td>CO₂ absorber for vent</td><td>: Required</td></tr><tr><td>(c)</td><td>Seal for overflow</td><td>: Required</td></tr><tr><td>(d)</td><td>Manhole & approach Ladder/platform/</td><td>: Required</td></tr></table>				Sl. No.	Description	Tech. Particulars	I.	Quantity	: One (1)	II.	Capacity	: 5 Cu.M (Minimum.)	III.	Type	: Horizontal Dished ends	IV.	Design Pressure	: Atmospheric	V.	Design Standard	: ASME Boiler and Pressure Vessel code Section-VIII/IS:2825 (Class 3)	VI.	Material of Construction	: Plates to IS:2062/ ASTM A36.Minimum shell thickness shall be 6mm.	VII.	ACCESSORIES		(a)	Vent, overflow and drain	: Required (Overflow drain to be taken upto 'O' M plant drain)	(b)	CO ₂ absorber for vent	: Required	(c)	Seal for overflow	: Required	(d)	Manhole & approach Ladder/platform/	: Required
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LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 5 OF 15																																				

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM	एनटीपीसी NTPC		
3.05.00	Construction features of Alkali dosing tank. Quantity per Unit : One (1) Useful Capacity of Each Tank : Suitable for the system (Minimum 500 lt) Size (Dia. x Height) : Adequate Type : Vertical cylinder, dished bottom Design Pressure : Atmospheric Design Standard : ASME Boiler & Pressure vessels Code Section-VIII. Div.I/ IS:2825 (Class-3) Material of Construction : MS Plates to IS:2062/ ASTM A36. with rubber lining of 4.5 mm thick & Minimum shell thickness shall be 6mm. OR SS plates of minimum thickness of 3 mm . Dissolving Basket : AISI-316, Agitator : Propeller type agitator of stainless steel 316SS construction along with drive motor of suitable rating and protection class. (With Slow speed reduction gear unit) Accessories (a) Vent, overflow and Drain : Required (b) Sample Connection : Required			
4.00.00	SIZING / DESIGN CRITERIA			
4.01.00	Pumps a) Flow : Auxiliary (secondary) cooling water pumps; Total secondary water design flow – As per system requirement (Less than or equal to maximum flow available as per Annexure-II). <u>Primary Water pumps.</u> Design flow of all Flue Gas Desulphurization system Auxiliaries coolers. b) Head : As per system requirement +10% margin on friction head.			
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CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM 		
4.02.00	c) Motor rating : Continuous motor rating (at 50 degree C ambient) for all pumps shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. d) No. of Primary side pumps : As indicated in Part A of the specification. e) No. of Secondary water pumps. : As indicated in part A of the specification. f) Re-circulation control Valves, Piping & Pressure break down orifice. : Required g) Additional design requirements : To be referred in the Annexure Sub-section titled "GENERAL SPECIFICATION FOR HORIZONTAL PUMPS" enclosed with this section.		
	Plate Type Heat Exchangers		
	a) Design Secondary water Inlet temperature	: Not less than 36 deg. C	
	b) Secondary water outlet	: Temperature as achieved subject to the maximum ACW flow indicated.	
	d) Overall fouling factor (minimum) (f)	: 0.8×10^{-4} Hr M ² deg C/Kcal	
	e) No. of heat exchangers/ unit	: As indicated in part A of the specification	
	f) Overall Heat transfer coefficient [U(o)]:	As per manufacturer's design	
	g) Dirty Heat transfer Coefficient [U(d)]	: $[1 / (1/U(o) + f)]$	
	h) Heat Transfer Area (Sqm)	: $\frac{\text{Total Heat Load (in Kcal/hr)}}{U(d) \times \text{LMTD}}$	
	i) Heat transfer area of PHE shall be selected such that each Sq.M of heat transfer plate shall transfer not more than 6500 Kcal/hr.		
5.00.00	INSTRUMENTATION		
5.01.00	All instruments, such as thermowell, temperature element alongwith temperature transmitter, flow element, pressure/DP and temperature gauge/transmitters/sensors/switches, DP switch, pH analyzer, Rotameter etc. alongwith associated devices should meet the requirement as specified in relevant sub-section of this Technical Specification and shall be sufficient to meet all interlock/protection & operation requirement.		
5.02.00	Minimum instrumentation required for the Equipment Cooling water system shall be as per tender P & I Diagram wherever included in the specification.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 7 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM	एनटीपीसी NTPC		
6.00.00	CONTROL / OPERATION PHILOSOPHY			
6.02.00	The pump suction valves, re-circulation valves and discharge valves shall be motor actuated type to enable remote operation.			
6.03.00	Pump suction valves shall be provided with required limit switches for interlock & control.			
6.04.00	The pumps shall be designed to operate under discharge valve open and as well as in close condition.			
6.05.00	Wherever more than one sump/tank is provided, Suction header shall be interconnected such a way that any of the sump/tank may be selected from the panel for operation.			
6.06.00	Any of the pump shall be selectable as standby duty. Standby pump shall come into operation on tripping of working pump or inadequate pressure in the discharge header.			
6.07.00	Suction and Discharge valves of pumps shall be interlocked with start/stop of respective pumps.			
6.08.00	Local emergency stop provision for each pump shall be provided.			
6.09.00	All the working pumps shall be interlocked with the suction level or suction pressure condition as the case may be. Pumps operation shall be interlocked with the high discharge condition so that the pump may not operate at shut-off pressure.			
6.10.00	Automatic inlet valves at supply line to each of the tank/sump shall be provided so that the valves shall open and close at low-level and very high-level respectively.			
6.11.00	A control valve shall be provided to maintain a constant pressure differential between the main supply and return headers of DM water. The valve will bypass flow to maintain a constant return header pressure to compensate for fluctuations in coolant flow to the process heat exchangers due to modulating control valves on the process coolers or if any cooler goes out of service in DM circuit.			
6.12.00	Alarm to indicate high differential pressure across self-cleaning filter strainers, heat exchangers as the case may be.			
6.13.00	Manually operating globe / regulating valves shall be provided in the water side of each of the cooler outlet for control of flow as specified in respective equipment specification.			
6.14.00	Detailed Interlock & protection logic to be implemented in FGD control system shall be provided by the contractor and the same shall be as finalized during detailed engineering.			
7.00.00	PAINTING			
7.01.00	All the equipments such as pumps, tanks and plate type exchangers of this system shall be protected against external corrosion by providing suitable painting as mentioned below. For painting of valves and piping, relevant section shall be referred to.			
7.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.			
7.03.00	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot-blasting etc as per the agreed procedure.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 8 OF 15

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7.04.00	For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.			
7.05.00	For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primer of minimum thickness of 50 microns followed up with undercoat of synthetic enamel paint of minimum thickness of 50 microns shall be applied. The top coat shall consist of two coats each of minimum thickness of 50 microns of synthetic enamel paint and thus total thickness shall be minimum 200 microns.			
7.06.00	Internal surfaces of ECW over tank shall be painted with One coat of unmodified epoxy resin alongwith polyamide hardener and minimum two (2) coats unmodified epoxy resin alongwith Aromatic adduct hardener and total thickness of primer and paint should not be less than 400 microns.			
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	Annexure-I to ECW system Specification GENERAL SPECIFICATION FOR HORIZONTAL PUMPS (ACW, ECW and CLARIFIED WATER PUMPS) (1) SCOPE This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps. (2) CODES AND STANDARDS The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards. (3) LIST OF APPLICABLE STANDARDS IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water IS : 5120 : Technical requirements of rotodynamic special purpose pumps API : 610 : Centrifugal pumps for general refinery service. IS : 5639 : Pumps Handling Chemicals & corrosion liquids IS : 5659 : Pumps for process water HIS : Hydraulic Institute Standards, USA ASTM-1-165-65: Standards Methods for Liquid Penetration Inspection. In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail. (4) DESIGN REQUIREMENTS (a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within $\pm 10\%$ of the rated design flow as indicated in data sheets. (b) The total head capacity curve shall be continuously rising from the operating point towards shut – off without any zone of instability with the highest head at shut-off condition. Shut-off head shall be more than the rated design head by 15 % or more for		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 10 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			एनटीपीसी NTPC									
(5)	radial flow pump and 25 % more than the design head for mixed flow/turbine type pumps. (c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable. (d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation: <table><tr><th><u>Speed</u></th><th><u>Antifriction Bearing</u></th><th><u>Sleeve Bearing</u></th></tr><tr><td>1500 rpm and below</td><td>75.0 micron</td><td>75.0 micron</td></tr><tr><td>3000 rpm</td><td>50.0 micron</td><td>65.0 micron</td></tr></table> The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface. (e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. (f) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal. (g) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.				<u>Speed</u>	<u>Antifriction Bearing</u>	<u>Sleeve Bearing</u>	1500 rpm and below	75.0 micron	75.0 micron	3000 rpm	50.0 micron	65.0 micron
	<u>Speed</u>	<u>Antifriction Bearing</u>	<u>Sleeve Bearing</u>										
	1500 rpm and below	75.0 micron	75.0 micron										
	3000 rpm	50.0 micron	65.0 micron										
	DESIGN CONSTRUCTION												
	(a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to. (b) Pump Casing Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation. (c) Impeller Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers												

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	shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation. (d) Impeller/Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations of pumps as per manufacturer's standard practice. Suitable method of locking the wearing ring shall be used. (e) Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation. (f) Shaft Sleeves Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation. (g) Bearings Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing. (h) Stuffing Boxes Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 12 OF 15

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	(i) Mechanical Seals Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped. (j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply. (k) Pump Shaft Motor Shaft Coupling The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided. (l) Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided. (m) Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment. (n) Drive Motor (Prime Mover) Continuous Motor rating (at 50.0 C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. The KW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s). (o) Auto Prime Unit (As applicable) Each pump shall be provided with an auto prime unit that will ensure the desired suction lift thus avoiding the requirement of manual priming. The priming unit shall be capable to prime from a completely dry volute and suction line. The priming unit shall consist of either vacuum pump or compressor with venturi arrangement as per proven practice of the pump manufacturer.			
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(6)	Performance Test The performance tests shall be carried out in two stages (i) After manufacture of pump, at shop (ii) After installation of all the pumps and completion of initial trial operation and test shall be conducted at site. (I) Performance Test at Shop After the manufacturing, the pumps shall be subjected to performance test at manufacturer's works which will include establishing the pump performance curve (Head-Capacity, Power-Capacity, Efficiency-Capacity), NPSH, measurement of vibration, noise level, bearing temperature etc., and verifying the guaranteed parameters in the presence of Employer's representative and pump supplier/manufacturer. For carrying out performance test at shop, actual motor and auto prime unit (if required) shall be used. (II) Performance Tests at Site After installation of the pumps, the tests shall be conducted to demonstrate the satisfactory operation of pumps. The parallel operation of the pumps shall be demonstrated/tested. There should be equal load sharing between pumps running in parallel with no abnormal vibrations, sound or hunting of head and flow. Load sharing between any pumps running in parallel should be within 10%. Bidder shall submit the testing procedure of the pumps for Employer's approval. Required calibrated instruments & measurement devices shall be provided by the Contractor.		
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	Annexure-II Maximum Auxiliary (Secondary) water available:- <table><tr><th>Sl. No</th><th>Project</th><th>Maximum water available (cum/hr)</th></tr><tr><td>1</td><td>FGUTPP STAGE-I,II & III</td><td>265</td></tr><tr><td>2</td><td>KAHALGAON STPP STAGE-I & II</td><td>585</td></tr><tr><td>3</td><td>FARAKKA STPP A) ST-I (3X200MW) B)ST-II(2X500MW) C)ST-III(1X500)</td><td>A) 160 B) 265 C) 125</td></tr><tr><td>4</td><td>SINGRAULI STPP A) ST-I(5X200MW) B) ST-II (2 X500 MW)</td><td>A) 265 B) 265</td></tr><tr><td>5</td><td>RIHAND STPP-I (2 X500 MW)</td><td>265</td></tr></table> System for each stages of each projects shall be designed separately with considering actual requirement of water corresponding to design points mentioned in the equipment cooling water system specification.			Sl. No	Project	Maximum water available (cum/hr)	1	FGUTPP STAGE-I,II & III	265	2	KAHALGAON STPP STAGE-I & II	585	3	FARAKKA STPP A) ST-I (3X200MW) B)ST-II(2X500MW) C)ST-III(1X500)	A) 160 B) 265 C) 125	4	SINGRAULI STPP A) ST-I(5X200MW) B) ST-II (2 X500 MW)	A) 265 B) 265	5	RIHAND STPP-I (2 X500 MW)	265
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SUB-SECTION-I-M6

LIMESTONE & GYPSUM HANDLING SYSTEM

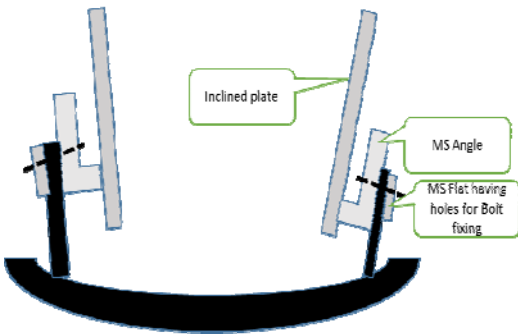
CLAUSE NO.	TECHNICAL REQUIREMENTS 																														
1.0.0 2.0.0 2.1.0 2.2.0 2.3.0	INTRODUCTION This section of the specification provides the detailed technical requirements for the Limestone & Gypsum Handling System. CODES AND SPECIFICATIONS All plant, equipment, systems and works covered under this contract shall comply with the latest editions including amendments of applicable codes, standards, statutes, regulations and safety rules as on the date of submission of bid. Particular care shall be exercised in observing compliance to the rules and regulations governing the locality where the plant is to be installed. Contractor's obligations in this regard shall not be limited to only those codes and standards mentioned in this contract. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility. In the event of any conflict between the applicable codes and standards and the requirements of this contract, the more stringent of the two shall govern. The specific codes / standards followed for the design of the system are as below and relevant codes are also indicated against each equipment: <table border="1"> <tr> <td>CEMA</td><td>Conveyor Belt Manufacturing Association</td></tr> <tr> <td>IS:11592 - 2000</td><td>Code of practice for selection and design of belt conveyors</td></tr> <tr> <td>IS:1891 - 1994</td><td>Conveyor and elevator textile beltings spec.Part.1 General</td></tr> <tr> <td>IS:14386 -1996</td><td>Belt conveyors-Traveling Tripper- Motorised for belt widths 650mm to 1600 mm- Dimensions</td></tr> <tr> <td>IS:8531-1986</td><td>Specification for Pulleys for Belt conveyors</td></tr> <tr> <td>IS:8598 - 1987</td><td>Specification for Idlers and idlers set for belt conveyors</td></tr> <tr> <td>IS 9295 - 1983</td><td>Steel tubes for Idlers for Belt conveyors</td></tr> <tr> <td>ISO 5049/1 or IS 800</td><td>Code of construction of structural works.</td></tr> <tr> <td>IS 16143 (Par 2& 4)/ ASTM C50// ASTM D2013</td><td>Lime stone Sampling System</td></tr> <tr> <td>IS:2062 - 2006</td><td>Steel for general structural purposes.</td></tr> <tr> <td>IS:1239 2004 part 1</td><td>Spec for mild steel tubes tubular and other wrought steel</td></tr> <tr> <td>IS:3589 : 2001</td><td>Steel pipes for water and sewage (168.3 to 2504mm outside diameter)</td></tr> <tr> <td>IS: 325</td><td>Three Phase induction motors</td></tr> <tr> <td>ASHRAE :2007</td><td>HVAC applications</td></tr> <tr> <td>IS 3832 : 2005</td><td>Manual hoist / CPB</td></tr> </table>	CEMA	Conveyor Belt Manufacturing Association	IS:11592 - 2000	Code of practice for selection and design of belt conveyors	IS:1891 - 1994	Conveyor and elevator textile beltings spec.Part.1 General	IS:14386 -1996	Belt conveyors-Traveling Tripper- Motorised for belt widths 650mm to 1600 mm- Dimensions	IS:8531-1986	Specification for Pulleys for Belt conveyors	IS:8598 - 1987	Specification for Idlers and idlers set for belt conveyors	IS 9295 - 1983	Steel tubes for Idlers for Belt conveyors	ISO 5049/1 or IS 800	Code of construction of structural works.	IS 16143 (Par 2& 4)/ ASTM C50// ASTM D2013	Lime stone Sampling System	IS:2062 - 2006	Steel for general structural purposes.	IS:1239 2004 part 1	Spec for mild steel tubes tubular and other wrought steel	IS:3589 : 2001	Steel pipes for water and sewage (168.3 to 2504mm outside diameter)	IS: 325	Three Phase induction motors	ASHRAE :2007	HVAC applications	IS 3832 : 2005	Manual hoist / CPB
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3.0.0	IS 3938 : 1983		Electric hoist	
	IS 3177 : 1999		EOT Crane	
	IS 4894 : 1987		Specification for centrifugal fan	
	IS 7155(part 5):1990		Code of Recommended Practice for Conveyor safety	
	The extraction capacity of dust extraction system shall be based on "American Conference of Governmental Industrial Hygienists"(ACGIH).			
	SYSTEM DESCRIPTION			
	The limestone handling system comprises the following: Unloading, Crushing and Stacking. Reclaiming and Limestone Bunker Feeding System			
	Unloading, Crushing and Bunker Feeding System			
	Two (2) numbers Box feeders/ Bulk material receiving unit/ Truck unloading system/ Surface feeder per unit (or group of units for which common FGD system is envisaged) for unloading of limestone from trucks/ self-tipping trucks/ loader shovels, This unit shall feed limestone onto the conveyor before crusher house. The complete truck unloading system must not have any underground structures/facilities.			
	A mechanized system shall be provided for unloading of limestone from trucks. The unloaded limestone shall be conveyed up to the limestone conveying stream before the limestone crusher.			
3.1.0	Unloading, Crushing and Bunker Feeding System			
3.2.0	Conveying			
	“As received” limestone shall be fed on the double stream conveyors from where the same shall be conveyed upto the crushers. The crushed limestone shall be conveyed by double stream conveyors up to the limestone storage shed. From the limestone storage shed (if lime stone storage shed is envisaged by bidder for storage of lime stone) paddle feeders will extract/ reclaim crushed limestone and feed the same onto double stream conveying system up to the limestone mill bunkers.			
	Crushing			
3.3.0	In limestone crusher house, limestone from each incoming Conveyor shall pass through one (1) or two (2) numbers , as applicable, of (dedicated) Vibrating screening Feeders and one (1x100%) or two (2x50%) numbers , as applicable, of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system. Each stream shall have a set of Rod gates and Rack & Pinion Gates before Vibrating grizzly Feeders to permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream. Limestone sampling unit shall be provided to sample the limestone from either stream.			
3.4.0	A passenger cum goods elevator of capacity 1088Kg shall be provided in limestone crusher house.			
	Limestone Storage and Bunker feeding system			
	Crushed limestone shall be stored in covered ground storage sheds using mobile trippers. The capacity of the storage shed shall be equivalent to limestone consumption for at least 7 days.			
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	Minimum Two (2) numbers Travelling trippers shall be provided one each on a conveyors. The Travelling trippers shall operate on rails for stacking the Limestone in the stock yard area. During reclaiming operation the reclaimed Limestone shall be conveyed to the conveyor by the Paddle feeders for Conveying to Limestone Bunkers. From Reclaim hopper, crushed Limestone of (-) 20mm size would be fed to Limestone bunkers through a series of belt conveyors, passing through various Junction Towers and ploughs/ fixed trippers.			
3.5.0	SYSTEM DESCRIPTION: GYPSUM HANDLING PLANT			
	Double conveyor stream shall be provided for conveying dewatered gypsum from gypsum vacuum belt filter to over ground storage under a shed near plant boundary. The storage shed shall be sized for 7 days of gypsum production with all the units in operation. Gypsum from storage shed shall be loaded to user's trucks using front end loader/ payloader.			
4.0.0	MAJOR EQUIPMENT OF LIMESTONE HANDLING SYSTEM AND GYPSUM HANDLING SYSTEM			
4.1.0	BELT CONVEYOR SYSTEM			
	The belt conveyor system shall confirm to the latest edition of the following standards & codes :			
	“Belt Conveyors for Bulk Materials” published by Conveyor Equipment Manufacturers’ Association.			
	IS:7155	:	Codes of Practice for Conveyor Safety.	
	IS:1891 (Part-I)	:	General Purpose Belting	
	IS:8598	:	Idlers and Idler Sets for Belt Conveyors	
	IS:4009 (Part-II)	:	Conical Head Grease Nipples	
	IS:8531	:	Pulleys for Belt Conveyors.	
	IS:2062	:	Hot Rolled Low, Medium and High Tensile Structural Steel	
	IS:4682	:	Codes of Practice for Lining of Vessels and Equipment for Chemical Processes.	
	IS:11592	:	Code of practice for selection and design of Belt Conveyors.	
	CAN / CASA - M422 M87	:	Canadian standard association.	
4.1.1	Belting:			
	The belting shall be of either synthetic fabric such as Nylon-Nylon etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg.			
	Belt Width: 800 mm (Min) for 150 MTPH			
	1200 mm (Min) for 1200 MTPH			
	For all the conveyors the number of plies, cover thickness, factor of safety etc. shall be as per the recommendation of belt manufacturer, but not inferior to the figures as tabulated in data sheet. Longitudinal joints in the plies of synthetic fabric belts is not permitted.			
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4.1.6 4.1.7 4.1.8 4.2.0	Quality). However, for conveyors with in line magnetic separators, the head end pulleys shall have shell and end disc made of non-magnetic stainless steel material. Suitable stiffening shall be provided at all weld location in the shell on all pulleys. All the pulleys shall be mounted on the forged steel shafts of EN-8 or equivalent material of adequate proportion by taper lock arrangement, running in heavy duty roller bearings with proper greasing arrangement. The plummer blocks for pulleys shall be of horizontally split type construction with minimum (4) nos. bolts holding the two split halves and with min (4) nos. foundation bolts. The plummer blocks shall be dust tight with double labyrinth seals. Conical head shape nipples conforming to IS:4009, suitable drain plug and eye bolt shall be provided. Side covers of plummer blocks shall be heavy duty metallic sheets. Drive Motors Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50 deg Cent. Ambient. Single LT drive motors shall be used for conveyor drive ratings up to 160 KW. For conveyor drive rating beyond 160 KW, single HT drive shall be used for conveyors. Conveyor Bridges All overground and overhead conveyors shall be located in suitably enclosed bridge structure. Structural steel bridges of adequate width and depth (2700 mm clear head room) shall be provided complete with conveyor bottom deck plates, seal plates, walkways of chequered plates with anti-skid arrangement(s), hand rails (on both sides of each conveyor belt except where equipment (like trippers etc.) traverse over conveyor supports. Side and central walkways for double streams conveyors shall be 800mm and 1100mm wide respectively. The side walkways for single conveyors shall be 800 mm on one side and 1100mm on the other side. All conveyors shall be provided with 12 G steel seal plates throughout the length of the conveyor gallery in such a way that complete gallery bottom surface area forms a single water proof floor and no water / limestone falls down from conveyor gallery incase of cleaning / washing. The conveyors shall be provided with continuous decking plate of minimum 3 mm thickness plain steel sheet. Provision shall be kept with platforms and ladders for crossing over the conveyors at approximately every 100m intervals of route length and minimum one per conveyor. Belt Vulcanizing Machine Belt Vulcanizing Equipment shall be suitable for hot vulcanizing of belt splice and shall be of easy-to-handle type. Equipment should be suitable for vulcanizing of entire splice width in single setting. Equipment should be capable of applying uniform pressure over the splice by pneumatic or hydraulic means. Heating element should be preferably of flexible type. ELECTRO HYDRAULIC THRUSTER BRAKES The necessary Electro Hydraulic Thruster (AC) brakes / disc brakes, totally enclosed and fail safe, shall be provided as required for various equipment's. Braking torque shall be adjustable from 0 to 100% of rated braking torque. The thruster brake shall be actuated by compression springs. The electro hydraulic thruster shall be fitted with the brake. Limit switches shall be provided for brake applied/released positions. The windings shall be provided with class-B insulation suitable for 415V $\pm$ 10% at 50 Hz $\pm$ 5% and combined variation of $\pm$ 10%. Brake lining shall be asbestos with inter woven brass wires capable of withstanding 200°C temperature. Clamp Electro-hydraulic thruster rail clamp shall be actuated by compression springs, the spring shall apply the clamping force directly on the Rail clamp mechanism once power supply is cut-off. The force transmission mechanism from spring to rail clamp faces shall be very			
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4.3.0 4.3.1 4.3.2 4.3.3 4.3.4 4.3.5 4.3.6	simple with minimum linkages. Manual rail clamp shall be provided with positive locking arrangement and shall apply clamping force directly on rails. The manual rail clamp shall be of proven design. MONORAILS AND HOISTS The Monorails & Hoists shall conform to the latest edition of the following standards & codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. IS:3938 : Specification for Electric Wire Rope Hoist IS:3832 : Chain pulley blocks IS:2429 : Round steel short link chain IS:6216 : Short link chain grade 80 IS:15560 : Points hooks with shank up to 160 Tonne - Specification IS:210 : Cast Iron Castings For the Hoists with more than 2.0 tonne lifting capacity or more than 10.0 M lift, with the exception of hoists for GTU and bend pulleys motor operated hoist blocks for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. All monorails coming out of the buildings shall be provided with electric hoist blocks, irrespective of load and lift. Minimum 3 meter length of Cantilever from edge of building/cladding, shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls / cladding and any other facilities beneath the floor upto ground level. Clear height shall be maintained when handling one equipment over other, in such case dismantling of any equipment shall not be permitted. The center line of monorail shall not deviate by more than 500 mm from the center of gravity of any equipment that is to be lifted. The electric hoist shall be designed and constructed in accordance with the latest revision of IS:3938 and shall be suitable for duty class 2. For electric hoists, trolley movement and hoisting shall be effected by using two separate motors. Motors shall be as per technical requirements discussed elsewhere. However the motors shall be suitable for 150 starts per hour at 40% CDF. Motor operated geared trolley shall have two (2) pairs of wheels, one pair of which shall be driven through motor. An electromechanical brake shall be provided for hoisting as well as cross travel. Brake lining shall be of asbestos Wire rope shall be of pre-formed type, hemp cored, regular lay 6/36 construction with a breaking strength of 160 -175 kgf/ sq. mm. Minimum number of falls of rope shall be four (4). All running shafts and wheels shall be fitted with ball / roller bearings with a rated life not less than 20 years based on equivalent running time as per IS:3938. All chain pulley blocks shall be designed to IS:3832, the operating hand chain shall conform to IS:2429 grade 30 pitched and polished and the load chain to IS:6216 grade 80. The chain pulley block shall be suitable for duty class 2. Hooks shall be as per IS: 15560 & with antifriction bearing. The hoist mechanism shall consist of a grooved rope drum driven by electric motor through gears. Each end of the rope shall be anchored to the drum in such a way as the anchorage is readily available for maintenance. Each rope shall have two (2) full turns of the drum when the hook is at its lowest position and one (1) spare groove when the hook is at its highest position. The leading rope taken by the drum should not slope sideways when slack and it should not be caught between the gear wheel.			
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4.4.3	 Flap gate i. The motor operated 2 position flap gates shall be provided in transfer chutes as specified and shall be complete with electrically operated actuators. The gates shall be of robust construction and suitable for trouble free operation. The face of the flap gate shall be made out of 20 mm thick TISCRAAL or equivalent material. The equipment shall be capable of being operated for at least 15 switchings per hour at rated load and thrust and shall be suitable for 10 Nos. consecutive switchings at rated load and thrust. The flap gate travel shall be in the range of 60 deg. to 70 deg. Suitable travel dependent limit switches controlling the travel of the flap gates on either direction shall be furnished. These shall be placed internal to the drive unit and shall be completely dust-proof. The limit switches shall be capable of adjustments to vary the total length of travel of the gates. Suitable thrust dependent limit switches shall be provided in the actuator, which shall trip off the actuator motor in case of excessive thrust due to jamming of the gates during its travel in either direction. The same shall also be integral to the drive unit and shall be dust proof. Approach/maintenance platforms complete with the chequered plate floor, hand rails, ladders etc. shall be provided for all flap gates. The platforms shall be extended for access to dust & debris chute inside buildings. ii. Provision for alternative manual operation shall also be made using declutchable hand wheel of 500 mm diameter. Limit switch for safety of person operating the hand wheel shall be provided. Manual effort required to operate the flap gate shall not exceed 25 kg. All the actuators in the plant should be selected based on heaviest loading, but the rating shall not be less than 2500 kg with a lever arm of 1.0 m in any case. For standardization purposes, only one standard type of actuator for flap gates shall be provided. iii. The material of shaft shall be EN-8 or equivalent. The diameter of the shaft shall be suitable for motor stalled condition and associated twisting. However, the diameter of the shaft shall not be less than 150 mm.			
4.4.4	Rod Gate Suitable manually operated rod gates shall be provided over rack and pinion gates for their easy operation and maintenance.			
4.4.5	Rack & Pinion Gate (i) The rack and pinion gate shall be guided properly and suitable rollers with bearings sealed for life and dust proof shall be provided. Rotary actuator operated rack and pinion gates shall be provided.			
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4.5.0 4.5.1 4.5.2 4.5.3 4.6.0 4.6.1	(ii) The rack and pinion gates shall be of mild steel construction with liner plate of 10 mm thick TISCRAI or equivalent material. The gates shall be operated by means of double rack and pinion. The material for rack & pinion wheel shall be cast steel and shaft shall be EN.-8. Provision for alternative manual operation (manual effort 25 kg) of motorized rack and pinion gates shall also be made. Limit switch for safety of person operating the hand wheel shall be provided. DRIVE EQUIPMENT Gear Box The gearboxes shall be designed for 24 hours continuous duty. Gearboxes with cooling coils or external cooling are not acceptable. The gears used shall be helical conforming to IS:3681 (latest revision) or worm reduction units or spiral bevel speed reduction units conforming to suitable Indian Standards. The dimensions of the shaft end shall conform to IS:3688 or its latest revision. Above 40 kW drive rating, all gearboxes shall be helical or bevel helical type only. all gearboxes shall have suitable breather plugs, dipstick, drain plug etc. Flexible / Rigid Coupling The design of the coupling shall be such that it can take shock and misalignment without sacrificing its efficiency. Geared type flexible coupling shall be used on low speed side for all conveyors and other drive chains where gear box is provided. Other couplings in the drive chains shall be either rigid or flexible type, depending upon the requirement of equipment design. Fluid Couplings Fluid couplings shall be provided in all the drive machinery for belt conveyor systems and limestone crushers if the actual power requirement at motor output shaft is more than 40 kW. The fluid coupling for LT motors shall be of traction type and for HT motors, shall be of scoop tube type. Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote. Manual operation may also be provided. Separate pump with motor or integral shaft driven oil pump shall be provided for circulating the fluid coupling oil through oil cooler. Forced cooling water supply to oil cooler shall be provided for which cooling water pumps to be provided for group of scoop couplings. Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for (LHP, GHP) and crusher scoop couplings. Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either lines falling below acceptable levels. Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all-relevant valves, and accessories. Necessary isolation valves shall be provided in the oil / water line for maintenance of any equipment in the line. Necessary interlock shall also be provided so that the HT motor cannot be started from remote / local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor. Temperature switch shall be provided in the oil circuit and shall trip the system in case of high oil temperature. The scoop tube operation must be such so to ensure draining of oil from the operating circuit by providing a double speed motor. The speed (for draining) shall be selected to match the coasting time of down stream equipment/conveyor. LIMESTONE HANDLING PLANT (LHP) BUILDINGS All LHP buildings shall have sufficient space to accommodate the entire equipment like head end, drive unit and tail end of various conveyors, chutes, control equipments, MCCs, batteries, supports for conveyor bridges, tensioning arrangements, approach/maintenance platforms with ladders, external / internal stairs, handrails, RCC floors, foundations etc.			
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4.6.2 4.6.3 4.6.4 4.7.0 4.7.1 4.7.2 4.7.3	Moreover, ample space shall be provided for maintenance purposes. Outside stairs to junction towers shall be open type. However, a weather canopy shall be provided at the top. Building floors shall be washed periodically with water for which necessary slope & drains shall be provided from each floor leading to minimum 4 nos down comers of minimum 273 mm OD each building. However for MCC, control buildings and pump houses, minimum 150 mm dia, 4 nos galvanized MS pipes conforming to IS: 1239 shall be provided. The system shall be designed considering water mixed with limestone. A drain pit shall be provided near each building to collect water/limestone mixture. Overflow from this pit shall be connected to nearest drain. 1 mtr x 1 mtr size dust/debris MS chutes from all the floors to ground floor shall be provided at all buildings/junction towers and limestone crusher house. The plate thickness shall not be less than 6mm. Openings in the floors of LHP buildings (i.e. JTs/CH etc.) shall be provided with curb of 100mm high to avoid water falling down to lower floors. Floor at ground shall be provided in all junction towers, ground conveyors etc. Level of floor at ground shall be 500 mm above ground/grade level unless noted otherwise. For enclosed ground conveyor 750mm wide plinth protection along with drainage arrangement shall be provided along the conveyor on both sides. Suitable opening at every 50mtr interval shall be provided on either side in a staggered manner for exit / entry of personals. Necessary drains must be provided all along the floors of ground conveyor. All vertical steel members (in Junction Towers/Transfer Points and Crusher House) supporting the conveyors, equipment shall be mounted on 150MM concrete pedestals above floor level to avoid their direct contact with water. TRAVELLING TRIPPER AND BUNKER SEALING ARRANGEMENT Mobile Trippers on bunker conveyors along with belt sealing arrangement shall be furnished and erected complete with rails, including necessary supporting structures, approach/ maintenance platforms with ladders and hand railings, trailing cables, all electricals including machine mounted local control panel & control panel on one end of Bunker. The Mobile tripper on bunker/yard conveyors shall be motor driven type. The tripper shall have provision for dropping limestone from conveyor onto both sides of tripper to the bunker/storage shed or back to the conveyor for the purpose of skipping intermediate bunkers (as applicable). The rating of tripper travel motor shall be adequate to move the tripper smoothly either in same or opposite direction to belt direction under fully loaded conditions. Adhesive weight requirement and tractive effort calculations shall be subject to approval of Employer. Coefficient of adhesion shall be considered as maximum 0.15. Minimum two drive axles shall be provided for tripper travel. Arrangement shall be provided at the starting point of the tripper to avoid folding of belt. In case of tripper running at a speed more than its rated speed due to chute jamming or other reason, conveyor shall trip and annunciation shall appear. Supply of adequate length of rails to cover the runway length for the motor driven tripper shall be included. The supporting structures for the rails with necessary end stops shall also be supplied under this specification. Suitable belt hold down guide pulley shall be provided over the concave curve of belt over tripper. The travelling trippers shall be provided with fail safe A.C. thruster operated brake of totally enclosed type which shall engage as soon as tripper travel motor stops. A.C. thruster operated rail clamps along with manual Rail clamps on both side of the tripper shall also be provided. Independent motorized linear actuator shall be provided to operate each flap gate of the tripper chute. The sealing belt shall be of suitable grade (minimum 2 plies) with 5 mm x 5 mm covers (fire resistant) in line with other conveyor belting. The belt shall rest on 20 x 50 mm MS plates spaced at 200 mm placed 50 mm below floor level, provided over the bunker slot on tripper floor for tripper conveyor. The width of the bunker seal belt shall be at least 100 mm more than the bunker slot opening.			
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4.7.4	The tripper shall run on rails (90 lbs/yd) with double flanged wheels. Rails for tripper travel shall be mounted on supporting structure of respective conveyors. Suitable system having encoders for monitoring position of tripper in DDCMIS shall be provided. In addition, travel end limit switches and end stops shall also be provided. Suitable access platform of chequered plate with ladders, handrailing and walkways on both sides shall be provided for access/maintenance of equipment on tripper. In addition, crossover platform shall be provided with tripper so that operator can cross the belt through the same. 3mm deck plate continuous shall be provided below carrying idlers on the trippers. Tripper discharge chute shall be of tapered section as shown in the sketch below. 
4.8.0	PLOUGH SYSTEM (IF APPLICABLE) As an alternate to travelling tripper (Alternate option applicable only for limestone mill bunkers) plough type system may be provided by the bidder. The plough type system shall consist of the following. - The system shall feed limestone to one bunker at a time. - The plough shall be retractable type. - Shall meet the capacity of the conveyor (150 TPH). - The scraper/plough would normally be kept up in idle position allowing material to pass through and interfere with next lowered scraper/plough. In case material needs to be discharged scraper/plough will be lowered and fixed to that position till material fill up the bunker. The scraper/plough should be motor/cylinder/coil operated for remote operation. - The system must contain containment skirt boards with dust seal along the discharge area. - The system shall be capable of unloading minimum 99% amount of limestone passing under it. - However the system shall be complete from operation, maintenance and safety point of view.
4.9.0	LIMESTONE CRUSHER AND VMS
4.9.1	General Hammer mill type crusher shall be provided for sizing the input limestone to a size which shall be suited for their limestone pulverizer and system. Crusher shall be supplied complete with accessories and subsystems.
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4.9.5	doors shall be of hinge connection with effective dust sealing arrangement. Hydraulically operated top cover of crushers shall be provided for quick inspection and replacement of hammers. The entire inside surface of crusher coming in contact with limestone shall be provided with abrasion resistant liners.																	
	v) DRIVE																	
	The hammer crusher will be driven through Electric motor, scoop type hydraulic coupling and gear box.																	
	The material of construction for major components of crusher shall not be inferior to the quality and standards as mentioned in data sheet.																	
	Design and construction features of hammer mill crushers offered by the bidder shall be similar to the crushers which are already working satisfactorily for same or higher capacity.																	
	Vibration monitoring system should be offered for crushers as indicative below:																	
	<table><tr><th>Sl.No</th><th>Equipment</th><th>Type</th><th>No.</th><th>* No. of location per equip.</th><th>Equipment bearing type</th></tr><tr><td>1.</td><td>Limestone Crusher</td><td>Radial ring</td><td>4</td><td>(2 Nos.) 1 at DE & 1 at NDE</td><td>As per manufacturer's design</td></tr></table>					Sl.No	Equipment	Type	No.	* No. of location per equip.	Equipment bearing type	1.	Limestone Crusher	Radial ring	4	(2 Nos.) 1 at DE & 1 at NDE	As per manufacturer's design	
	Sl.No	Equipment	Type	No.	* No. of location per equip.	Equipment bearing type												
	1.	Limestone Crusher	Radial ring	4	(2 Nos.) 1 at DE & 1 at NDE	As per manufacturer's design												
	Vibration shall be measured at each location in Horizontal as well as vertical direction.																	
4.9.6 Not used																		
4.10.0 VIBRATING FEEDER / VIBRATING SCREENING FEEDER																		
GENERAL																		
Vibrating feeder shall be provided below the silos for limestone. Vibrating screen feeder shall be provided to feed limestone to crushers.																		
4.10.01 CODES & STANDARD																		
The design, manufacture, inspection and testing of Vibrating Feeder shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Vibrating Feeder shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Project Manager shall be final and binding. IS:3823 - Dimensions for vibrating conveyors and feeders with rectangular or trapezoidal trough.																		
4.10.02 DESIGN REQUIREMENTS																		
The vibrating screening feeder shall be of electromechanical grizzly type and shall be provided to feed limestone to crusher. The drive unit shall be complete with mechanical type of vibrator. The vibrating screening feeder shall be suitable for lumps size of (-) 250 mm. The Feeder shall be designed to feed limestone to the crusher .The flow of material shall cease as soon as vibration of the trough or pan Ceases.																		
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4.11.4	suitable for the entire length of the hopper upto maintenance bay. Mechanical track stops alongwith buffers on each end of rails and on paddle feeders shall also be provided. For specification of Dry type Dust Extraction System for paddle feeder, refer relevant Sub-section of this Specification. vi. For designing the paddle wheel as well as travel drive, Contractor shall consider the hopper fully loaded with limestone on either side of the paddle wheel to the maximum capacity. The hydraulic system normal average working pressure shall be selected considering the above loading condition. Further hydraulic system shall be designed to stall / trip beyond a certain pressure above the normal average working pressure. The minimum margin between the normal working pressure and the stall / trip pressure shall be 50%. The maximum working pressure for the hydraulic system in Hydraulic power pack shall not be more than 210 bar. vii. Feeder carriage drive shall be suitably designed so that the forward & reverse movement of carriage can be achieved without stopping the scooping operation. Tank filled with water in DS system shall also be considered for travel drive. Capacity of tank mounted on tail end side shall be sufficient for half an hour operation. viii. Rail structure shall be designed considering two-wheel support and accounting no frictional force from the other two wheels and considering hydraulic motor stall condition. ix. For selection and specification of drive motors (other than the hydraulic motor), gearboxes, all types of couplings associated with paddle feeder and other equipment, relevant sections of this specification shall be referred to. x. Contractor's design of paddle feeder should not incorporate a separate loading table (impact cradle) below the paddle feeders. However, the height of fall of limestone between paddle wheel and conveyor belt shall be kept minimum. Hydraulic components shall be provided with dust proof cover for protection against spillage of lime/ dust. Pressure /Temperature gauges shall be located at convenient locations for continuous observation by operator. Proper oil level gauge to be provided at hydraulic oil reservoir tank. xi. Three (3) pairs of Control cables shall be provided in the control trailing cable of each machine for connecting Employers telephone and P.A. equipment to be provided on each machine. xii. For Hydraulic system, in case the oil temperature is high then proper external cooling is to be provided , viz, heat exchanger, before the oil returns back to the oil tank.			
	Construction requirement i. The paddle feeders shall run on rails mounted on the supporting structures of associated conveyors. Both paddle feeder and carriage drives shall be mounted on the feeder carriage. ii. The paddle feeder wheel shall comprise of suitable numbers of vanes with cutting edges. The vanes shall be of high strength steel construction with removable TISCRA / SAILHARD / LSLAS07 liner plates. Vanes shall be easily removable individually. Tip of the vane shall reach inner most point of hopper table. iii. The feeder carriage shall be of steel construction and of robust design. Skirt plates shall be provided integral with the equipment for collecting the material drawn by the paddle feeder from the storage shed hopper and discharging on to the conveyor			
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	belt. Feeder skirts of paddle feeders shall be extended at least by 500 mm on either side of the paddle wheel to avoid spillage of limestone. Necessary baffle/retainer plates for suitably guiding the flow of limestone from storage shed hopper to the reclaim conveyor being fed by paddle feeders shall be provided. Hand railing shall be provided on the top deck of feeder carriage together with an access ladder. iv. The feeder carriage shall be provided with suitable number of double flange wheels of steel construction, complete with sealed bearing unit. The drive mechanism shall be suitable for continuous reversible motion of the carriage. Start/stop switches shall be provided at the local control panel for the operation of paddle wheel and feeder carriage. The carriage shall automatically reverse its motion, when two paddle feeders operating on the same track come within a predetermined distance. Suitable anti-collision device (infrared and mechanically operated limit switch type) shall be provided. Provision shall be made to trip the limestone conveyor from respective paddle feeder and provision shall be made for tripping of paddle feeder from LHP main control room. v. Rope actuated stop switches shall be provided along the travelling structure for emergency use. vi. Suitable indication of paddle wheel 'rpm' shall be provided on the paddle feeder control panel and flow rate indicator of belt weigh scale shall also be duplicated on control panel of paddle feeder. Operating controls shall be mounted at a suitable height such that it can be operated from walkway. Encoder shall be provided on the paddle feeder to give 4-20 mA signal to the DDCMIS to the exact location of the machine. vii. Suitable rail cleaners shall be provided at the leading as well as trailing side of the feeder carriage for both tracks. viii. Suitable cable trays/troughs shall be provided along the travel of paddle feeder for supporting and guiding the trailing cables. In order to save flexible cables from damage due to tension/over-tension protection switches shall be provided. Isolating switch to isolate the power supply to the machines shall be provided in each power JB to be located at the center of travel length. ix. Various equipment of Paddle Feeder assembly shall be easily accessible. It shall be possible to replace electrical, mechanical and hydraulic components of paddle feeder when positioned at hopper. Various drive equipment and hydraulic/other components shall be so arranged that limestone spillage from hopper mouth does not accumulate near/over them. x. Provision shall be kept for automatic tripping of limestone conveyor in the event of paddle feeder getting dragged (i.e. travel speed in excess of rated speed). Paddle feeder once tripped due to jamming or operation of emergency push button shall not start unless the hydraulic pressure is back to "normal". xi. Paddle feeders rails should be mounted on continuous running member. The splicing of rails shall necessarily be at vertical support location only. Splicing in between vertical support will not be accepted. xii. The longitudinal distance between two vertical supports shall be 3000 mm (min.)			
4.12.0	LIMESTONE SAMPLING UNIT			
4.12.1	The limestone Sampling Unit shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.			
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4.12.2 4.12.3 4.12.4 4.12.5 4.13.0 4.13.1	ASTM-D-2234 : Standard Methods for collection of a Gross Sample of Coal. ASTM-D-2013 : Standard Method of Preparing Coal Samples for Analysis ASTM-C-50: Standard practice for sampling, sample preparation, packaging and marking of limestone and limestone products. The Limestone sampling units suitable to give "Samples" conforming to ASTM-D-2234 shall be selected by the Contractor for taking samples from any of the two streams running at guaranteed capacity. The different Equipment selected for Limestone sampling unit shall be such that there shall be no loss of fines and moisture from the samples. The normal input feed size shall be considered as (-) 250 mm for limestone sampling unit before limestone crusher. However occasionally (-) 400 mm lumps may also arrive. Limestone lump size after limestone crusher shall be as per crusher output size. Primary samplers (separate for each conveyor) shall be rugged, able to withstand severe shock loads and operate trouble free. Belt feeders shall be provided for entire sampling path upto sample collector. For rejects path also, belt feeders shall be preferred. Screw conveyors for the same shall be accepted only where space constraints do not permit distribution of limestone rejects to receiving conveyor below. Sample crushers shall be provided for reducing the main input feed limestone to 95% minus 8 mesh size and 99 % minus 4 mesh size. Single stage crushing shall be provided. There should be no re-circulation of fines in the crushers. 'Lot size' shall be equivalent to limestone quantity handled in 8 hours operation assuming average conveyor loading at 75% of rated conveyor capacity. Belt feeders shall be positively self cleaning and have dust tight construction. It shall be provided with flanged belt, rubber lagged head pulleys and inspection doors. No chain/belt drives shall be accepted. The crusher's base should be built of reinforced concrete and be sufficiently large in mass. The sample chutes shall have minimum valley angle of 60 degrees to horizontal and shall be of stainless steel plates. The chutes shall be suitable to handle wet sticky limestone as specified elsewhere. The welding of chutes shall be done externally only. The inside surface of the material near welds shall be smooth. Radius at corners not less than 1" shall be provided in chute work. All solid connected members shall be by means of bolting flanges with at least 6 mm thick standard grade neoprene gasket material between the metal flanges. No control gates to regulate the flow of material shall be incorporated in the chute work. Bias connections shall be provided at suitable locations. The materials rejected from samplers shall be returned to main conveyor stream. Minimum 4 nos. sample collecting bins shall be provided with auto indexing. The bins shall be provided with air tight connection. The system shall be suitable for operation through DDCMIS. DUST CONTROL AND MISCELLANEOUS SYSTEM The dust control system to be furnished under this specification is required for control of fugitive dust emissions from dust generation points such as junction towers, truck un-loading points, crushers etc. Dust control is achieved by dust extraction system. Service water system, potable water system, cooling water system & sump pumps shall also be provided. <i>All pumps/ compressors envisaged to meet dust control and miscellaneous system requirements for LHP/GHP shall be provided with 100% standby.</i> Each pump houses shall have one no. dedicated over ground tank. Each tank shall be sized for ½ hour storage capacity considering maximum water drawn in order to meet the specified requirement. Tank shall be completely enclosed and provided with man hole and access ladder (internal and external). All areas around tanks shall be paved with concrete and shall have proper drain.			
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4.13.2	Service Water and cooling Water System Service water and Cooling water distribution system (for scoop coupling) complete with water supply system, valves, quick couplings, hose pipes with nozzle, piping, pumps, drive motors with canopy, couplings with enclosure, electricals, including supporting structures, handling for equipment's, civil and structural works and necessary accessories shall be provided throughout the limestone handling system.			
4.13.3	The Dust Control & Miscellaneous Systems shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted IS:778 : Gun Metal gate, globe & check valves for general purpose. BS:5150 : Cast Iron Gate Valve for water works purposes BS:5152 : Cast Iron Globe Valve for water works purposes BS:5312 : Cast Iron Check Valve for water works purposes S:1239 : Mild Steel tubes & fittings. IS:2379 : Colour for the identification of pipe line. IS:3589 : Electrically welded steel pipes for water, gas & sewage (200 to 2000 mm) IS:5312 : Swing check type reflux (non return) valves. IS:1520 : Horizontal centrifugal pump for clean, cold fresh water. IS:5120 : Centrifugal pump for clean, cold & fresh water. IS 2825 : Air Receivers. ANSI B 31.1 : Code for pressure piping. Hydraulic institute Standards of U.S.A			
4.13.4	Sump pumps alongwith level switches & piping upto nearest Employer's drain (max upto 50.0 mtrs. from outside the building) shall be provided at all locations wherever natural drainage is not possible. The capacity of each pump shall not be less than 50 m³/hr. Minimum 10% margin on capacity and 20% margin on computed head shall be considered for selection of pumps. Size of the drain pit shall not be less than 2.0 meters x 2.0 meters x 1.8 meters deep. One no. of settling pit shall also be provided before sump pit so that water without heavy limestone particles goes into sump pump pit. High and low level switches shall be provided in the sump pump pit.			
4.13.5	Service water connections are to be provided in conveyor galleries and tunnels at 50 meter intervals. Adequate number of these connections shall be provided in all junction towers with minimum one no. at each floor and with minimum two (2) nos. at each floor in limestone crusher house. Each connection shall be provided with one (1) no. 32 NB globe valve and quick coupling. One (1) no. hose pipe with nozzle shall be provided in each building.			
4.13.6	Potable water connections are to be provided in all junction towers, limestone crusher house, all tripper floors, and all control rooms/MCC rooms and toilets etc. Water shall be drawn from the water storage tank by electric motor driven pumps and discharged via a pipe work system to the overhead drinking water storage PVC tanks of 250 litres capacities. The drinking water storage tanks shall have provision for maintenance & drain.			
4.13.7	Hoists with monorail of adequate capacity shall be provided in the service water / potable water pump houses			
4.13.8	The pumps shall be complete with drive motors, base plate and other accessories. Pump casing may be axially or radially split. Impeller shall be made in one piece and securely keyed to the shaft. Wearing surface shall be of hardened material and shall have a hardness difference of at least 50 BHN. The design of the shaft shall take into consideration the critical speed, which shall be at least 20% away from operating speed. Pump bearings shall be of antifriction type. Pump speed shall be less than 1500 rpm for pumps of capacity more than 10 m³/hr. The power, head and flow characteristics of each pump shall be suitable for			
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	parallel operation. The Power characteristics of the pumps shall be of non overloading type. All rotating parts of the pumps shall be statically and dynamically balanced. Design duty point of pump shall match with the average value of maximum and minimum flow rates of the pump in the stable operation zone.			
4.13.13	The sump pumps shall be of wet pit types, vertical shaft and impeller shall be specially designed to pass large solids or unscreened liquids. The construction and material shall be suitable for pumping limestone/dust contaminated water with a minimum of maintenance. All bearings of the pump shall be located above the water level.			
4.13.14	In general pipe sizes 65 mm NB and larger are to be joined by butt welding and pipe work of size 50 mm NB and below by socket welding/screwed connections. Joints at valves or specialities shall be flanged for sizes 65 mm NB or large and screwed for sizes 50 mm NB and below. All galvanised piping shall be joined by screwed connections. Minimum pipe diameter selected for DS/SW/PW/Cooling Water System (along with branch pipes) shall be 32 NB. However, for dry fog DS system, the minimum pipe size shall be 20 NB.			
4.13.15	Valves & Specialities shall be used to start, stop or regulate the flow. All valves/specialities below 50 mm size in service water/dust suppression/ potable water lines should be plug type. Gate/slucice valves shall be used for isolation of flow of pipe lines above 50NB and Globe valves shall be used for regulating the flow. All gate and globe valves of size 65 NB and large shall be bolted bonnet, outside screw, rising type with flanged ends. Valves of size 50 NB and smaller shall be with screwed ends. Non-return valves shall be swing check type. These valves will have a permanent 'arrow' inscription on its body to indicate direction of motion of the fluid.			
4.13.16	Strainer shall be of duplex type designed with 3 way valves so that one filter can be cleaned while the other is in operation. Suitable vent and drain valves shall also be provided. Screen opening area shall be at least four times the pipe cross sectional area. Pressure drop in clean conditions shall not exceed 1.5 MWC at full flow.			
4.13.17	The dust control and miscellaneous system to be supplied for limestone handling plant may be clubbed with the dust control and miscellaneous system for coal handling plant under this package.			
4.13.18	Dust extraction system for Limestone Handling area: Dust extraction system for limestone handling system with lime stone storage yard shall be dry type comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper. The limestone dust collected in dust collection hopper shall be periodically emptied back to the conveyor leaving the building. Bidder to provide bag filter and fans along with other auxiliaries for dust extraction in case of lime stone storage silo.			
4.13.19	Limestone storage area dust extraction system: a) For dust control in limestone storage shed during stacking and handling of limestone, roof extractors, ducting and collection hopper with bag filters shall be provided. The dust collected in the dust collection hoppers shall be periodically emptied back to the reclaim conveyor below the shed. b) For the paddle feeder provided for the reclaim hopper below the limestone storage shed, the dust extraction system comprising of suction hood, ducting and trolley mounted dust collection hopper with bag filters shall be provided. The dust collection hopper shall be periodically emptied back to the reclaim conveyor.			
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4.14.0	VENTILATION SYSTEMS			
4.14.1	Mechanical Ventilation system The air quantity for mechanical ventilation system shall be estimated based on equipment and solar heat loads and the temperature rise inside the building. Necessary air filters shall be provided to supply only clean air into building. Exhaust air shall be discharged at a suitable height above building. The ventilation system generally consisting of adequate number of supply and exhaust air fans, air filters, ducting along with 3 phase AC motor drives, electricals, supporting structures, approach/maintenance platforms, civil and structural works and necessary accessories shall be furnished for ventilating the underground portion of junction towers, underground conveyor tunnels. Exhaust fans shall be provided for tripper floor, Toilets, Battery rooms. The exhaust fans for toilets and battery rooms will be propeller type and for tripper floors will be axial flow type complete with rain protection cowl and bird screen.			
4.14.2	Pressurised Ventilation System The pressurised ventilation system having adequate nos. of supply air fans with washable metallic pre filters, HDPE fine filters, and self closing flap (gravity louver shutter), ducting along with 3 phase AC motor drives, electricals, supporting structures, access / maintenance platforms shall be provided in all MCC/switchgear room areas of limestone handling plant to be furnished under this specification. The pressurized ventilation system shall be designed considering 15 air changes per hour to maintain these areas pressurised slightly above atmospheric pressure to prevent ingress of dust from outside			
4.14.3	Air Conditioning System Air conditioning system shall be furnished for control room area of main LHP control building (if applicable) and in electrical buildings. It shall be designed considering the equipment heat loads, solar heat loads, heat gain into the room, adequate no. of air changes etc. to maintain a uniform temperature and relative humidity within the air conditioned areas. 2x100% capacity air conditioning units with air cooled condensers shall be provided on the following basis. a) For areas where air conditioning load is in the range of 5-15 TR, Non-ductable ceiling mounted (cassette type) or wall mounted (high wall type) split air-conditioners of suitable capacity along with adequate redundancy shall be provided. b) Ductable split/package type A/Cs shall only be provided for control rooms where the load varies in the range 15- 25 TR. c) Central air conditioning system shall be provided for control rooms where the load varies in the range 25-60 TR. Window ACs shall be provided for RIO room (if applicable). Supply and return air distribution ducting complete with insulation, of resin bonded mineral wool equivalent of density at least 24 kg/m ³ and thermal conductivity of max. 0.49 mw/cm°C conforming to IS: 8183 including supporting structures, approach/ maintenance platforms, civil and structural works and necessary accessories shall be provided.			
4.14.4	The Ventilation & A/C System shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. IS:3588 : Specification for electrical axial flow fans. IS:2312 : Propeller type AC Ventilation fans IS:3963 : Specification for roof-extractor units IS:4894 : Centrifugal Fans IS:655 : Specification for Metal Air Duct ARI:210 : Standard for Unitary air conditioning equipment.			
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	ARI:270 : Standard for application, installation and servicing of unitary equipment. IS:8183 : Specification for bonded mineral wool. IS:661 : Thermal insulation for cold surfaces. IS:4671 : Expanded polystyrene for thermal insulation purpose. IS:8148 : Packaged Air conditioners			
4.14.5	Axial Fans Design duty point of the fan shall match with the average value of maximum and minimum flow rates of the fan in the stable operation zone. The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1440 rpm for fan with impeller diameter 450 mm and less. The first critical speed of rotating assembly shall be at least 25% above operating speed. Impellers shall be axial flow type and single piece cast aluminum with aerofoil blades construction and shall be mounted directly on the motor shaft. It shall be finished all over and balanced dynamically. Rain protection cowls will be designed to suit wall exhausters/supply fans for protecting fans/motors from rain. It will be provided with bird screen. Inlet cone or bell and outlet cone shall be provided as required. It should be made of G.I. or M.S.			
4.14.6	Centrifugal Fans The fan units shall be centrifugal type with radial bladed impeller. For design, purpose outdoor ambient temperature shall be taken as 50 deg.C. All fan mountings shall have adequate arrangement for vibration isolation. The reverse flow through non-working fan shall be prevented by dampers. The dampers shall be made out of 18 SWG MS sheets. Design duty point of the fans shall match with the average value of maximum and minimum flow rate of the fan in the stable operation zone. Split casing shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required. The impeller shall have die formed curved blades fabricated out of MS heavy gauge welded to the rim and back plate to have a non overloading characteristics of the fan. Rim shall be spun to have a smooth contour. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts. The impeller along with driven pulley shall be dynamically balanced. Fan shaft shall be of EN-8 equivalent. The bearings shall be self-aligning heavy-duty ball or roller bearings. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside			
4.14.7	Metallic Filters Metallic cleanable filters shall be provided as required. Max. air velocity considered shall be 2 m/sec. Metallic cleanable filters shall consist of V-fold galvanized wire mesh interspaced with a flat layer of galvanized wire mesh. The density of the filter medium shall increase in the direction of airflow. Wire mesh edges shall be suitably hemmed to eliminate the danger of abrasion during handling. Filter medium shall be supported on either side by galvanized expanded metal casing. Filter frame shall be constructed from galvanized sheet of thickness not less than 18 gauge.			
4.14.8	HDPE Filters HDPE filters should have an efficiency of 90% down to 5 microns. Velocity across the filter shall be limited to 2.5 m/sec. HDPE filters shall be provided as required. To facilitate periodic cleaning of filters by water washing, tap or service water connection near the filters shall be provided.			
4.14.9	High efficiency filter (for A/C purpose) High efficiency filter (for A/C purpose). Filtration efficiency shall not be less than 99% down to 5 microns. Pr. drop across the filter under clean condition shall not be more than 10 mm			
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4.14.10	w.c. The media of the filter shall be made from either special synthetic non-woven bond fiber design or made from micro fiber glass media. It shall be supported with GI wire mesh or aluminum mesh and shall be housed in an aluminum sheet frame. It shall be of washable type several times. Packaged Air-Conditioning Unit PAC units shall be factory tested and assembled self contained units complete with refrigerant compressor, coils, fans, insulation and wiring. Various parts of PAC units wherever required shall be insulated with expanded polyethylene conforming to IS:4671. The PAC unit shall comprise of an evaporator (indoor air) blower section and an air cooled condenser (outdoor air) section. Heavy gauge steel cabinet finished with paint of approved colour, shall be used to house components of PAC. The evaporator and condenser coils shall be arranged for direct expansion cooling and shall be formed of aluminum fins mechanically bonded to seamless copper tubes and electrically tinned. The inter-connecting refrigerant circuits shall comprise of hermetically sealed scroll compressor and motor with all necessary isolation valves, with adjustable set point, sight glass, copper tubing and pipeline ancillaries. The condenser coils shall be air cooled by propeller type fans complete with safety guards. The condensing coils The evaporator air blower(s) shall be centrifugal forward curved type belt driven by individual motor(s) and suitable for the external static pressure. The fan assembly shall be isolated from the casing by anti-vibration mounts. The fan/motor drive shall be capable of capacity adjustment by pulley changes within +15% of design duty shall be suitably arranged to avoid radiant heat pick-up from solar sources. Condenser capacity control shall be provided by means of fans and 'head pressure' sensing. High efficiency filters shall be provided in the main supply air duct and in the fresh air connection to return air duct. A separate cubicle shall be provided within the overall casing to house the thermostatic controls, which shall be electric/electronic solid state, prewired and tested. The refrigerant system shall be protected by pressure limiting devices, electric and thermal overloads and unloading facilities to provide the required control range tolerances. A low voltage room thermostat or RTD based temperature sensing device shall be provided for wall mounting. The casing shall be fitted with all necessary coil drains and service connections/ entries. PAC (duty/standby) units shall be selected manually and be ON/OFF switched. The units shall be fully packaged and incorporate integral room air sensing control thermostats and manufacturers work fitted safety interlocks. All controls shall be prewired to unit mounted control/power terminal boxes.			
4.14.11	Ventilation and Air Conditioning system ducting All GI sheet metal ductwork required for ventilation and air conditioning system shall be furnished by the supplier. All ducts and plenums unless otherwise noted shall be constructed out of standard quality galvanised steel sheet. All sheet metal ducts shall be fabricated and installed in conformity to the requirements of IS: 655. Steel supports for the ductwork shall be furnished as required. The thickness of ducting steel shall be 1 mm min. For ducting with large size exceeding 1000 mm it shall be 1.2 mm. The flexible connection between fan and ducting shall be on teflon impregnated canvas. The zinc coating on GI sheet shall be 275 gm/m²			
4.15.0	BELT SCALE			
4.15.1	The Belt Scales shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.			
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4.15.2	NEMA NEC For electronic circuit enclosures. IS:11547 Electronic weighing in motion system The weigh scale shall be automatic and electronic type. It should be designed for continuous automatic weighing, metering and printing of limestone flow. Each belt weigh scale shall comprise of a belt weigh scale platform with minimum 4 nos. weighing idlers. It shall have unitised construction for ease of installation and shall be fully floating type (without pivot points). Minimum 4 nos. hermetically sealed load cells of precision strain gauge type shall be applied in tension to support the weigh bridge. The load cells shall have 100% overload protection and shall be structurally safe upto to 250% of rated belt scale capacity. Belt scale shall be electronic microprocessor based with its program stored in non-volatile memory. It shall be provided with self diagnostic features for trouble shooting of the entire belt scale system. Fully automatic zero and span calibration facility shall be provided. The flow rate indicator shall have minimum 4 digits. The flow totalizer should have 8 digits display scale with reset facility. Complete belt scale system shall be suitable for 50°C ambient temperature and 100% relative humidity. It shall be suitable for out door installation in a dusty area. The electronic circuit enclosure, sensors housing shall be dust and watertight. The electronic printed circuits shall be encapsulated with epoxy or other suitable material for protection against dust and moisture. Minimum three years battery back up power failure protection shall be provided.			
4.15.3	Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of atleast ($\pm$) 0.25 percent throughout its range. Per two (2) belt weighers, the contractor shall furnish one (1) necessary test load chain sets required for calibration and periodic testing of the equipment. The test load chain shall be 'two idler spaces' longer than the weighing length of the weighers and shall be complete with chain reset equipment with weight adding reels of adequate size. The calibrated weight parameter length of the test chain shall be stamped at a suitable location on the body of the equipment. Alternatively, supply of test weights for calibration of belt scales is also acceptable.			
4.16.0	IN-LINE MAGNETIC SEPARATOR AND SUSPENDED MAGNET			
4.16.1	Inline Magnetic Separators shall be provided for continuous and automatic extraction and discharge of tramp magnetic pieces from limestone being discharged from conveyors as specified. The sets shall be complete in all respects with drives, magnets, inline belts, hoppers, chutes, tramp-iron boxes and all electrical ancillaries like control panels etc. Suspended Magnetic Separator shall be provided for picking up tramp magnetic pieces buried under limestone from moving Conveyor.			
4.16.2	Magnet core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminum wire with class 'H' insulation, to limit the absolute temperature of the winding to 140 deg. centigrade. The oil used for cooling the ILMS and SM shall be silicon based.			
4.16.3	The 'Force Index' i.e. the product of flux density in gauss and rate of change of flux density w.r.t. distance, at the bottom of falling material trajectory shall be 100,000 (gauss x gauss/inch) minimum in hot condition for mounting height of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. However, the strength of the magnet shall not be less than 1000 gauss in hot running condition at distance of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. The minimum strength of the magnet shall be 1000 gauss at the specified mounting height at the centre of Belt width. Contractor shall select magnet width to suit above. Characteristic curve of magnet with the value of flux density varying between 50 mm to face of conveyor belt shall be provided. The cross section of magnet shall be suitably designed to provide sufficient area for magnetising the			
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	coil effectively covering full cross section of the discharge material. The magnetic separator shall be located such that it picks-up tramp iron from limestone trajectory after it has been discharged from head pulley.			
4.16.4	The tramp magnetic pieces buried under limestone picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided upto ground level. All conveyors with magnetic separator at head end shall have non-magnetic SS pulleys. Head pulleys of all conveyors with in line magnetic separator at head end shall be provided with SS shell and end disc. However, hub and shaft shall be of same materials as in other pulleys (EN-8 or equivalent). The motor and the gear reduction unit for driving the in-line belt shall be adequately sized with minimum 20% margin to avoid any over loading during operation. Suitable zero speed switch shall be provided. No Chain/belt drives shall be accepted. The belt shall be designed to withstand high temperature at the bottom of the magnet and any serious damage due to the impact of the sharp edges of the tramp iron. The belt shall be provided with rubber cleats spaced suitably. The belt shall be of fire resistant grade.			
4.16.5	The magnetic separator units shall be supported by suitable structural member from the top by taking support from the operating floor beams with turn buckle arrangement to facilitate the necessary adjustments during operation. Further, electric Hoists operated cross travel arrangement shall be provided to move magnetic separator away to facilitate maintenance of the conveyor discharge pulley/Belt. ON/OFF control push buttons with indicating lamps shall be provided at the local station. The materials of chutes and hoppers associated with magnetic separators above the drive floor shall be SS-304 in the magnetic zone. Other chutes shall be of 1 mtr. sq. dimension and shall be made of MS. Chutes shall have poking doors at all floors to clear jammed material.			
4.16.6	Suitable arrangements shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use. Protection against high oil temperature in magnet shall be provided.			
4.17.0	METAL DETECTOR			
4.17.1	Metal detectors shall be provided at specified location to detect metallic objects in the limestone stream. Metal detectors shall have high reliability with enough sensitivity to detect 25mm aluminum sphere below the burden of limestone in case of synthetic belting. However, for steel cord belting the sensitivity shall be 35mm. It shall also detect other metals, like brass, copper, stainless steel, manganese steel, bars, scraps etc. The equipment shall have provision for automatic static calibration with adjustable sensitivity.			
4.17.2	Metal detectors shall be completely solid state using latest state of art technology. It shall be suitable for 50°C ambient and RH of 100%. The search sensor shall be protected from rain and direct sunlight by means of a non metallic covering other than wood. Control unit shall have adjustable controls for sensitivity, ON/OFF push buttons, resettable operation counter, audio-visual alarms local remote selector switch and all other necessary controls for trouble free operation of metal detector. It shall be suitable for mounting on wall, column, structure etc. with IP-65 Degree of protection. It shall be constructed from FRP of thickness not less than 2mm.			
4.17.3	The coils shall be protected against being struck by an oversized material. The coils should have adjustment for magnetite/iron in incoming limestone. It should ignore magnetite/iron and shall distinguish between metal pieces and magnetite/iron. In order to counteract interference from external sources such as motors, lightning and radio-transmitters, and to nullify the effect of climate changes/aging, dual receiver coils are to be used. In order to allow passing of steel cord belt and metal belt fasteners without giving alarm and at the same time detecting tramps, suitable arrangements shall be provided. In case a few non-magnetic idlers or non magnetic deck plates are required, the Contractor shall provide these. However, these shall be metallic. Wood is not to be used. LED display of COAST COUNT			
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	to indicate the number of pieces of tramp iron detected since last reset shall be provided so that the operator is alerted for the pieces of tramps, if any, between tramp marker and coil before restoring conveyor. TOTAL COUNT, which is not resettable, shall also be provided on the same LED display on demand. The location of tramp metal pieces shall be indicated by sand bag marker.			
4.17.4	Fiber glass enclosure (with IP 65 degree of protection) shall be provided for all type of coils Local control panel shall be provided with IP:65 degree of protection.			
4.18.00	BOX FEEDER OR BULK MATERIAL RECEIVING UNIT OR TRUCK UNLOADING SYSTEM OR SURFACE FEEDER: The Box Feeder should be a robust, proven, above the ground for unloading from trucks/ self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder.			
4.19.00	BUCKET ELEVATOR SYSTEM			
4.19.01	General Requirement The type (Centrifugal/Continuous) of the Bucket Elevator shall be chosen by Bidder for the material and conditions specified. The Bucket Elevator shall be sized to handle the design capacity at the specified material bulk density & maximum material size. The equipment shall be complete with all necessary sub-systems and components and shall be designed and supplied in conformance with the attached datasheets, site conditions, specific Employer’s requirements and applicable International, National, State and Local codes. The Equipment shall be complete in all aspects and all items required for erection/smooth operation shall be in Bidder’s scope, unless otherwise noted in exclusions. Sizing of the equipment and components shall be the responsibility of the Bidder, based on the service conditions specified.			
4.19.02	Codes and Standards All design, fabrication, testing, supply and erection, if applicable, shall conform to the latest edition of all the relevant standards and regulations issued by the governing bodies. Bidder shall follow the applicable INDIAN/INTERNATIONAL codes by the following organizations. EN European Norm IEC International Electro technical Commission ISO International Organization for Standardization DIN German Institute for Standardization (To be used when no EN standards exist) Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.			
4.19.03	Design Requirement			
4.19.04	Design Criteria The equipment shall be designed for continuous twenty-four hour service. The Equipment shall be designed for service in a heavy duty industrial application, handling abrasive materials in a dusty environment.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.19.05	Casing			
	The Bucket Elevator should be sized to handle the design capacity as indicated on the Data Sheet with the minimum material bulk density and a maximum bucket filling of 75%.			
	Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform.			
	Head section is to be split and equipped with handles or lifting lugs for easy removal. Access and inspection doors are to be provided.			
	Intermediate sections are to have a minimum plate thickness of 4 mm.			
4.19.06	Buckets			
	Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels.			
	A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.			
	Size, capacity and type of buckets and appropriate reinforcement necessary for the application shall be adequately sized. Provide pin holes in bottom of buckets for air relief, as necessary, when handling materials such as Lime stone or gypsum. Bucket width is to be a minimum of four times the maximum particle size.			
	Chain Type Elevator:			
4.19.07	Chain type bucket elevator to be provided.			
	Pulley			
	Drive and guide pulleys shall be provided as specified else where in the specification and shall be at least the minimum recommended for belt conveyor pulleys.			
	Head Shaft and Bearings			
	The bearings on head shaft to be antifriction type with one bearing fixed and the other expansion. All bearings are to have an L ₁₀ life of 60000 hours.			
4.19.08	Foot Shaft and Bearings			
	The tail shaft is to be of hardened steel with tool steel sleeves operating in heat treated white iron bearings. All bearings are to have an L ₁₀ life of 60000 hours.			
	Take-up			
	Take-up shall be screw or internal gravity type with guide rails and weights included.			
	4.19.09	Drive		
Bucket elevator drive should be sized as follows:				
Minimum power for drive, either:				
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.19.13 4.19.14 4.19.15	100% bucket filling @ minimum material bulk density, or 75% bucket filling @ maximum material bulk density, whichever is greater. Inspection and Access Doors Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5m minimum. Dust Vent A dust collecting vent in the head section and boot section shall be furnished with drilled flanges. Bidder quote is to include recommended vent volumes for the boot and head sections of the elevator. The Pick-Up velocity shall not be greater than 2.5m/sec. Drive Equipment The Drive Equipment for Bucket Elevator shall be as specified else where in the specification.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET for each of above system and equipment is as below : DATA SHEET: BELT CONVEYOR 1.0.0 GENERAL 1.1.0 Design Capacity 110% of rated (guaranteed) capacity for all conveyors. 1.2.0 Maximum slope 16 deg 1.3.0 Max. belt Sag between idlers 2% 1.4.0 Minimum Radius (i) Concave curve 250 m (In case of travelling trippers, the requirement of minimum radius shall be decided based on the space availability) (ii) Convex Curve 50 m 1.5.0 Limestone Parameters As specified elsewhere 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Belting 2.1.1 Type Synthetic Fabric of Nylon / Nylon 2.1.2 Cover Grade a) Flame test : Conforming to ISO:340 b) Drum Friction and Electrical Surface Resistance Test: Conforming to Canadian standard association CAN / CSA M-422- M87 Grade - C. 2.1.3 Cover Thickness (without –ve Synthetic belting Steel Cord tolerances). (a) Face 5.0 mm (min.) 8.0 mm (min.) (Inclusive of steel or fabric breaker) (b) Bottom 2.0 mm (min.) 6.0 mm (min.) (Inclusive of steel or fabric breaker) 2.1.4 No. of plies Minimum 3 2.1.5 Drive Arrangement Snub drive	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET : BELT CONVEYOR 2.1.6 Factor of Safety - 10 (Minimum) for N-N belt. - 7 (minimum) for Steel Cord Belt. 2.1.7 Normal Working tension at design capacity Less than 80% of max. allowable working tension 2.2.0 Idlers 2.2.1 Type (a) Carrying Three roll, 35 degree troughing, 2 degree forward tilt (b) Return Single Roll, For conveyors upto 400 m c/c length. Two roll with 10 degree angle for conveyors more than 400 m c/c length (c) Loading point Impact type 2.2.2 Spacing (a) Carrying idlers 1.2 m (0.6 m for convex curves). (b) Return idlers 3.0 m (for convex curves not more than 1.5 m.) (c) Loading point Minimum six (6) with 400 mm spacing. (d) Self-aligning troughing idlers At 10 m distance from head & Tail pulleys with intermediate spacing 15m (e) Self - aligning return idlers At 10 m distance from Head & Tail pulleys with intermediate spacing 20m. (Not required for conveyors more than 400m c/c long where 2 roll return idlers are provided). 2.2.3 Bearings (a) Carrying Ball Bearings of deep groove type or seize resistance type of min. 30 mm size, lubricated for life. (b) Return Ball Bearings of deep groove type or seize resistance type of min. 20 mm size, lubricated for life. 2.2.4 Material (a) Roller ERW Steel tube min. wall thickness 4.0 mm	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(b) Spindle	EN- 8 or equivalent.	
2.3.0	Belt Cleaners		
2.3.1	External	Spring loaded scraper type cleaner with modular, segmented and replaceable PU blades with separate main-cleaner & pre-cleaner etc.	
2.3.2	Internal	V-Plough type, mild steel flats with hard rubber strips.	
2.4.0	Belt Take up		
2.4.1	Type	Automatic Gravity Type.	
2.4.2	Location	In relation to the drive to keep belt tension at minimum.	
2.4.3	Take-up travel	To suit all operating conditions or (2.5% for synthetic belt and 0.5% for steel/cord belt) of conveyor center to center length whichever is larger. Further the initial location of take-up shall be decided in such a way that it is possible to carryout min. two (2) nos. Vulcanizing Joints without adding any external belt.	
2.5.0	Hold Back Device	Integral with gear Box	
2.6.0	Pulleys		
2.6.1	General (for all types of Pulleys)		
	Pulley shaft diameter	Margin of minimum 20% shall be Considered on maximum tension at design capacity for arriving at the shaft dia.	
2.6.2	Drive Pulleys		
	(1) Lagging	Hot lagged with vulcanized natural rubber	
	(2) Lagging thickness	12 mm thick grooved in diamond pattern with grooves 6 mm wide x 6 mm deep	
	(3) Minimum angle of wrap	210° degrees	
	(4) Maximum Out of roundness	0.5% of nominal diameter	
2.6.3	Other pulleys		
	(1) Lagging	Hot lagged with vulcanized natural rubber	
	(2) Lagging thickness	12 mm thick plain	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.6.4	Rubber for lagging (1) Type Natural rubber blended with styrene Butadiene rubber. (2) Hardness 55 to 65 durometer (Shore A) (3) Elongation Over 300% (4) Strength 160-245 kg/cm² (5) Abrasion loss 250 mm³ (max.) as per DIN 53516 (6) Specific Gravity Max. 1.5 (7) Adhesion Strength 10 kg/cm (minimum)	
2.6.5	Bearings for Pulleys (1) Type Heavy duty roller type (2) Casing Horizontal Split Type (3) Sealing Dust tight with double labyrinth seals. (4) Lubrication Greasing arrangement with conical head shape nipples.	
2.6.6	Pulley Material Mild steel conforming IS:226 / IS : 2062	
2.6.7	Shaft Material Forged Steel shaft EN-8 or equivalent material.	
2.7.0	Belt Protection Equipment	
2.7.1	Emergency Stop Switch System (1) Type Pull chord type (manually reset) (2) Location Both sides of conveyor for entire length (3) Spacing Approx 30 m	
2.7.2	Belt Sway Switches (1) Type Limit switches snap action. (2) Spacing One pair at 50m interval (Minimum two (2) pairs)	
2.7.3	Zero Speed Switches (1) Type, Location Proximity switch, mounted on Bend pulley of GTU.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.8.0 2.8.1 2.8.2 2.8.3 2.9.0 2.9.1 2.9.2 2.10.0 2.10.1	Drive Motors Type Three Phase Squirrel Cage Induction Motors Mounting (for conveyors) Base mounted Continuous motor rating (Name plate rating) at 50°C Ambient 120% of actual power requirement at motor output shaft at design capacity. Conveyor Bridges Walkways (a) Construction Chequered plate with antiskid arrangement. Chequered plate steps shall be provided where conveyor slope exceeds 10 degrees. (Totally sealed so that no water falls down while washing.) (b) Central walkway width 1100 mm (c) Side walkway width 800 mm (for single conveyors, the width of side walkways shall be 800 mm on one side and 1100 mm on the other) Side Windows (a) Spacing (Center to center) 25.0 m on each side (in staggered fashion) (b) Size 1.2 m x 1.5 m (c) Window material Refer Civil Section Trestles Spacing of monkey ladders on trestles (a) Where height of conveyor gallery (walkway level) is 10 m or more. : On every trestle (b) Where height of conveyor gallery (Walkway level) is less than 10m. : On alternate trestle	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET: BRAKES AND CLAMPS			
1.0.0	GENERAL			
1.1.0	Brakes	(i) For decelerating of conveyors & rotating equipment's.		
		(ii) Brakes are mandatory for H.T. drives involving scoop type coupling.		
1.2.0	Rail Clamps	For various mobile equipment travelling on rails.		
2.0.0	DESIGN & CONSTRUCTION REQUIREMENT			
2.1.0	Brakes			
2.1.1	Type	Electro Hydraulic Thruster brakes A.C. operated or Disc brakes.		
2.1.2	Braking Torque	Adjustable from 0 to 100% of rated braking torque.		
2.1.3	Brake Shoes	Operated directly by spring		
2.1.4	Shoe lining	Asbestos with interwoven brass wires.		
2.1.5	Max. Temperature for shoe lining	200 degree C.		
2.1.6	Thruster	Class-B insulation, IP-65 protection.		
2.2.0	Clamps			
2.2.1	Rail Clamp support	Independent from the rails.		
2.2.2	Limit Switches	“ENGAGED” & "DISENGAGED” signals.		
2.2.3	Clearance between Rail clamp face & Rail surface	Minimum 50 mm		
2.2.4	Material for Rail clamp Mechanism	Forged steel		
2.2.5	Thruster	Class-B insulation, IP-65 Protection		
2.2.6	Type	Electro hydraulic thruster, manual		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: MONORAILS AND HOISTS 1.0.0 GENERAL 1.1.0 Functional Requirement : To transfer equipment's to maintenance area or outside the building. 2.0.0 DESIGN & CONSTRUCTION REQUIREMENT 2.1.0 Hoists 2.1.1 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 takeup pulley and takeup weight Manual for both travel & lift. 2.1.2 Maximum trolley travel speed for electric hoists 15m/min 2.1.3 Maximum Hoisting speed for electric hoists 6 m/min 2.1.4 Drive Motors SQIM, Separate for travel & lift 2.1.5 No. of starts for drive motor 150 starts/hr at 40% CDF 2.1.6 Wire Rope (i) Type/Construction Pre-formed type, hemp cored, regular lay 6/36 construction (ii) Breaking Strength 160-175 kgf/sq. mm 2.1.7 Bearing (i) Type Ball/Roller bearing (ii) Life 20 years 2.1.8 Brake Electro Mechanical type with asbestos lining. 2.1.9 Load Hook Swiveling type forged circular shank section. 2.1.10 Duty Class –2 2.2.0 Monorail location/layout 2.2.1 Cross section I beam 2.2.2 Distance between C/L of monorail & C.G. of equipment to be lifted Maximum 500 mm	
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
2.2.3	Power Cables Support Festoon type arrangement		
2.3.0	Manual Hoists		
2.3.1	Maximum manual effort for operation. 30 kg		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: CHUTES AND HOPPERS 1.0.0 GENERAL 1.0.1 Limestone Parameters As specified elsewhere 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Chutes & Hoppers 2.1.1 Minimum Valley Angle 60 degrees 2.1.2 Material : (a) Chute work (b) Sliding zones & adjacent sides 20 mm thk. TISCERAL / equivalent (c) No striking/ Non sliding zones 10 mm thk MS (d) Chute with valley angle 80 degree and above All four sides of 20 mm thk. TISCERAL/equivalent material (e) In the zone of magnetic field of ILMS (chute above floor over which ILMS is suspended) SS-304 10 mm thk. (f) In the zone of flap gates 20 thk TISCERAL/ equivalent material (g) Discharge Hoods over head pulleys 4 mm thk M.S. with rubber curtain 2.1.4 Inspection Doors Hinged & leak proof construction (min. size 350 x 450 mm) 2.1.5 Chute Construction (a) Corners One face of removable bolted flange connection (b) Joints Bolted Flange joints of dust tight construction (c) Bolt size Min. M-16 (d) Bolts spacing Not more than 125 mm C/C (e) Fixing Arrangement Bolts with plain spring washers 2.2.0 Skirt Boards 2.2.1 Length Entire feeding chute shall be extended minimum 3 m ahead of front edge of chute & 500 mm beyond rear edge of chute. 2.2.2 Height Not less than 750 mm	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.2.3	Width	2/3 of belt width		
	Side plate	Min. 10 thk TISCRAL/equivalent		
	Top cover	6 mm thk M.S.		
2.3.0	Flap Gate			
2.3.1	Type	Linear actuator operated, 2 position		
2.3.2	Travel	60 to 70 deg. (with limit switches on both sides).		
2.3.3	Automatic operation			
	(i) Drive	Dust tight motor driven with suitable linkages		
	(ii) Minimum Actuator Rating	2500 kg with 1 m lever arm		
	(iii) No. of Operation / Hr	15 (with 10 consecutive switchings)		
	(iv) Protection	Travel and Thrust dependent limit Switches.		
2.4.4	Manual Operation			
	(a) Maximum effort	Convenient for single operator by declutchable hand wheel regardless of electrical power.		
	(b) Minimum Hand wheel Diameter	500 mm		
2.4.5	Flap gate shaft			
	(i) Diameter minimum	150 mm		
	(ii) Material	EN-8		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: DRIVE EQUIPMENT 1.0.0 GENERAL 1.1.0 Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors a) For conveyors of belt conveyor systems *120% of actual power at drive motor output shaft at specified design capacity b) Mobile trippers travel drive, mono-rail hoists (travel and hoisting), various pumps of DS systems, service water systems, cooling water system, potable water system and Ventilation Fans *110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity. *The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train. 2.0.0 DESIGN & CONSTRUCTION REQUIREMENT 2.1.0 Gear Box TYPE 2.1.1 (a) Below 40 kW Helical, worm, bevel as per requirement without cooling coil (b) Equal to and Above 40 kW Helical / bevel helical without cooling coil 2.1.2 Service Factor As per accepted engineering practice / manufacturer's recommendations . 2.1.3 Ambient temperature for Thermal rating 50° C Minimum 2.1.4 Mounting On Machined/Ground Surfaces 2.1.5 Output Rating a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment } @ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues. 2.1.6 Duty 24 Hrs. Continuous 2.1.7 Rating Not less than motor name plate	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.1.8	Thermal Rating	rating Corresponding to 50 Deg ambient Temp and in any case shall not be less than motor rating.	
2.2.0	Flexible Couplings		
2.2.1	Type	Geared coupling.	
2.2.2	Rating	Not less than motor rating.	
2.3.0	Fluid Couplings	For all motors having rating more than 40 kW.	
2.3.1	Type		
	(a) L.T. Motors	Traction type	
	(b) H.T. motors	Scoop tube type.	
2.3.2	Rating	Not less than motor nameplate rating	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET: LHP BUILDING 1.0.0 GENERAL 1.1.0 Under ground Junction tower (JT) RCC 1.2.0 Over ground Junction tower Steel Construction 1.3.0 Control/MCC rooms RCC 2.0.0 DESIGN & CONSTRUCTION REQUIREMENT 2.1.0 Junction tower & Crusher House 2.1.1 Space requirement To accommodate all equipments drive units, head/ tail ends of conveyors transfer chutes etc. and to provide adequate space for maintenance. 2.1.2 Floors RCC construction with facility to wash the floors. Min. slope of 1:80 for floors in JTs shall be provided towards drain pipes. 2.1.3 Walls/Enclosure Permanently colour coated cladding 2.1.4 Stairs Steel construction with minimum 1000 mm width. 2.1.5 Doors & Windows Steel construction 2.1.6 Monorails Capacity as per equipment installed 2.1.7 Drainage From each floor to drain pit suitable to handle limestone slurry. 2.1.9 Vertical bracing Only along four sides. 2.1.10 Maintenance platform with handrails. Chequered plate floors Min.1500 mm wide 2.1.11 Flooring 50 mm thick metallic hardener like ironite floor finish. 2.1.12 Level of ground floor 500 mm above ground level.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET: TRAVELLING TRIPPER 1.0.0 GENERAL 1.1.0 Mobile Tripper Motor driven type rail mounted. 1.2.0 Bunker Sealing Arrangement Sealing belt type. 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Mobile Tripper 2.1.1 Mounting Rail mounted on rails (90 lbs/yd) with double flanged wheels. 2.1.2 Drive Motor driven with suitable gearbox. Suitable for minimum 60 starts/hours. 2.1.3 Pulleys (a) Head & Bend Pulleys As specified elsewhere 2.1.4 Brakes AC operated electro hydraulic thruster type on either side of tripper. 2.1.5 Clamps Manual Rail clamps on either side of tripper. 2.1.6 Walkways Both sides of tripper, 800 mm wide each 2.2.0 Bunker Sealing Arrangement 2.2.1 Sealing Belt (a) No. of plies Minimum two (b) Top/Bottom cover Thickness 5 mm/5 mm (Fire Resistant) (c) Width At least 100 mm more than bunker slot. 2.2.2 Guide Rollers As per requirements. 2.2.3 Bunker Slot (a) Width As per tender drawing (b) Cross bars over the slot opening 12 mm x 50mm MS grating			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: DUST CONTROL & MISCELLANEOUS SYSTEM GENERAL 1.0.0 1.1.0 Dust Control Dust extraction system 1.2.0 Miscellaneous systems Service water system, Potable water system, Cooling water system, sump pump and DE system pumps 2.0.0 DESIGN REQUIREMENT 2.1.2 Pumps 2x100% for water 2.6.0 Service Water System 2.6.1 Water connections (a) Conveyor Galleries every 50 m (b) Junction towers Min. 1 no. at every floor 2.6.2 Connection details 32 NB plug valve 2.6.3 Hose pipes with hose reel One in each building of 25 mtr. Length with nozzle 2.7.0 Potable Water System 2.7.1 Pumps 2 X 100% electric motor driven 2.7.2 Water connections a) Junction towers Minimum one (1) no. at each floor (b) Tripper floor Minimum one (1) no. at every tripper bay. 3.0.0 CONSTRUCTION REQUIREMENTS 3.1.0 Water Supply Pumps for SW/PW/CW/DE 3.1.1 Casing Axial or radially split with drain & vent connection 3.1.2 Impeller One piece, keyed to shaft along with locking device 3.1.3 Shaft Critical speed atleast 20% away from operating speed 3.1.4 Shaft sleeves At bearings & stuffing boxes. 3.1.5 Bearings Antifriction type 3.1.6 Wearing rings Renewable type (preferable)	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.1.7	Pump speed Below 1500 rpm for capacity more than 10 m ³ /hr.	
3.1.8	Head flow characteristics Suitable for parallel operation.	
3.1.9	Materials	
	(a) Casing	Cast Iron to IS:210, FG 260
	(b) Impeller	Bronze conforming to Gr.I of IS:318
	(c) Impeller Wearing ring	Bronze conforming to Gr.I of IS:318
	(d) Casing Wearing ring	Bronze conforming to Gr.I of IS:318
	(e) Shaft	Medium carbon steel
	(f) Shaft sleeve	Stainless steel conforming to AISI-416 hardened.
	(g) Gland packing	Impregnated teflon
3.2.0	Sump Pumps	
3.2.1	Type	Wet pit type vertical shaft
3.2.2	Duty	Capacity to handle large solids or unscreened liquid.
3.2.3	Materials	
	(a) Casing and rotor housing	Ni-Cast Iron (350 BHN)
	(b) Rotor	Ni-Cast Iron (350 BHN)
	(c) Shaft	Medium carbon steel
	(d) Gland	Bronze
	(e) Wearing rings	Stainless steel
	(f) Shaft enclosing tube	Carbon steel
3.3.0	Pipings & Fittings	
3.3.1	Joints	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	10 kg/cm² (g) (i) Body Gun metal to IS:318, Gr-2. (ii) Trim Gun metal to IS:318, Gr-2. (b) Duplex Strainer (i) Body MS fabricated (ii) Strainer Stainless steel type element AISI-316 (c) Pressure Gauge/Switch (to be provided with isolating valves, gauge cock, snubber and syphon) (i) Dial size 150 mm (ii) Accuracy (+/-) 1% of range span (iii) Bourdon AISI 316 SS (iv) Block AISI 316 SS (v) Movement AISI 316 SS (vi) Case and Bezel Die cast Alum. Weather proof case stove enameled block with screwed type inner bezel of ABS plastic and glycerin filled. (vii) No. of contacts 2 NO + 2 NC (viii) Type of contact Adjustable throughout the range. (ix) Degree of protection IP. 65 (d) Solenoid valve (to be provided with isolating valve) (i) Type 2/2 way Diaphragm type pilot operated (ii) Diaphragm molded synthetic rubber (iii) Body Forged brass / SS (iv) Pressure 0.5 to 10 kg/cm² (g) (v) Protection Class IP 65 (e) Flow Switch (to be provided with isolating valves) (i) Body Forged steel	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(ii)	Extension Rod/wire	SS-304	
	(iii)	Sleeve and Sleeve pipe	SS-304	
	(iv)	Cover	Die cast aluminum	
	(v)	Max. working pressure	10 kg/cm ² (g)	
	(vi)	Repeatability	± 0.5%	
	(vii)	No. of contacts	2 NO + 2 NC	
	(viii)	Type of contact	Adjustable throughout the range.	
	(ix)	Protection class	IP – 65	
	(f)	Level Switch		
	(i)	Type	Displacer operated magnetic type	
	(ii)	Displacer	SS – 316	
	(iii)	Wire rope	SS – 316	
	(iv)	Spring Housing Spring and sleeve pipe	SS – 316	
	(iv)	Cover	Cast Aluminum	
	(v)	No. of Contacts	2 NO + 2 NC	
	(vi)	Type of Contact	Adjustable throughout the range.	
	(viii)	Protection class	IP – 65	
	(g)	Level gauges		
	(i)	Type	Float type mechanical gauge with arrow scale	
	(ii)	Accuracy	(+/-)1% of full scale range	
	(iii)	Material of construction		
	(aa)	Float & Guide wire	316 SS	
	(bb)	Elbows	Suitable grade of SS	
	(cc)	Housing	Mild Steel	
	(dd)	Cable fastener	SS 304	
	(h)	Dry Fog Dust Suppression Nozzles		
	(i)	Type	Fogging, non-clogging type	
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CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS		
	(ii) Material Stainless Steel (iii) Nozzle housing To ensure protection of nozzle against damage. (i) Y Strainer (a) Body SS 304 (b) Plug SS 304 (c) Filter Element SS 316, 60 mesh		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	Page 47 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DATA SHEET: VENTILATION SYSTEM			
1.0.0	GENERAL			
1.1.0	Mech. Ventilation System	To provide ventilation using fans for specified areas.		
1.1.1	No. of air changes per hour			
	(a) For over ground building	Not less than 10 supply air changes		
	(b) For under ground building	Not less than 15 supply air changes and 7 exhaust air changes		
1.1.2	Equipment			
	(1) Underground tunnel	Centrifugal fans/Axial fans		
	(2) All other places	Axial fans, roof ventilators		
1.3.0	Air-conditioning system			
1.3.1	Temperature to be maintained	24 ± 1 deg. C		
1.3.2	Humidity to be maintained	60 ± 5% relative humidity		
1.3.3	Fresh Air intake	Minimum 1.5 air changes per hour.		
1.3.4	Equipment	2 x 100 % roof mounted package AC units along with ducting etc. and 2X100% window AC		
1.4.0	Outside Ambient Conditions			
		As per weather data given in project synopsis		
2.0.0	DESIGN & CONSTRUCTION			
2.1.0	Axial Fans			
2.1.1	Capacity	10% more	of	actual requirement
2.1.2	Head	20% more	of	actual requirement
2.1.3	Speed			
	(a) Impeller dia above 450 mm	Max. 960 rpm		
	(b) Impeller dia less than or equal to 450 mm	Max. 1440 rpm		
	(c) Critical speed	25% above operating speed.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9		SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.2.0	Centrifugal Fans	
2.2.1	Capacity	10% more of actual requirement
2.2.2	Head	20% more than actual requirement
2.2.3	Speed	Max. 1500 rpm
2.2.4	Outdoor temperature	50 deg.C.
2.2.5	Rating	Continuous
2.3.0	Packaged Air-Conditioning Unit	
2.3.1	Type	Roof top mounting
2.3.2	Service/application	Continuous, round the clock
2.3.3	Capacity	
	(i) TR	Suitable
	(ii) CFM	Suitable
2.3.4	Type of compressor	Hermetically sealed scroll compressor
2.3.5	Condenser	Air cooled type
2.3.6	Fan	Forward curved centrifugal fan
2.3.7	Filter	High efficiency filter
2.3.8	Cooling Coil	
	(a) Type	Direct Expansion
	(b) Material	Copper
	(c) Fins	Aluminum mechanically bonded.
2.3.9	Refrigerant Piping	Copper
2.3.10	Insulation for PAC parts	Expanded polyethylene of density at least 15 kg/m ³ .
2.4.0	Filters	
2.4.1.	Metallic Filters	
	(1) Max. air velocity	2 m/s.
2.4.2	HDPE filters	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.4.3 2.5.0 2.5.1 2.5.2	(1) Efficiency 90% down to 5 microns (2) Max. velocity 2.5 m/s (3) Testing As per BS 2831 / Sqv. High Efficiency Filter (1) Efficiency 99% down to 5 microns. (2) Pr. drop across 10 mm W.C. (3) Testing As per BS 2831 / Sqv. Insulation for A/C Ducting Resin Bonded Mineral wool as per IS:8183 Density 24 kg/m³ Thermal conductivity 0.49 mw/cm deg.C	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET : BELT SCALE 1.0.0 GENERAL 1.1.0 Ambient Temperature 50°C 1.2.0 Relative Humidity 100% 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Type Electronic load cell type 2.2.0 Operation Microprocessor based fully automatic 2.3.0 No. of floating idlers Minimum four (4) 2.4.0 Load Cells 2.4.1 Type Strain gauge type hermetically sealed 2.4.2 Minimum Nos. Four (4) 2.4.3 Overload protection 100 % of rated belt scale capacity 2.4.4 Structural capacity 250 % of rated belt scale capacity 2.5.0 Flow Rate Indicator Electronic Digital Display Minimum 4 digits 2.6.0 Flow totalizer 8 digit display with reset facility. 2.7.0 Accuracy For entire range of 20% to 120% of rated capacity Minimum $\pm 0.25\%$ 2.8.0 Calibration 2.8.1 Automatic Zero & span calibration 2.8.2 Manual With test load chain (a) Test load chain length Two idler spaces more than weighing lengths (b) Chain reel equipment Complete with weight adding facility.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	Page 51 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: ILMS/SM 1.0.0 GENERAL 1.1.0 Type In line or suspended magnet type as specified. 2.0.0 DESIGN & CONSTRUCTION 2.1.0 In-line Magnetic Separator / Suspended Magnet 2.1.1 (a) Location of ILMS Over discharge pulley. (b) Location of SM Over Conveyor (as per tender drawing) 2.1.2 Force index (As defined earlier) Minimum 100,000 2.1.3 Strength of magnet at the specified mounting height 1000 gauss. 2.1.4 Mounting height Mounting height of In Line Magnetic Separator and Suspended Magnet shall be 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone (between top of conveyor belt & surface of magnetic separator) 2.1.5 Magnetic Separator Belt (i) Drive Unit Adequately sized with 20% margin. (ii) Belting Suitable to withstand high temp. & impact of tramp iron. (FR Grade) (iii) Discharge Into Tramp iron chute. 2.2.0 Tramp Iron Items (i) MS cube of 20 mm size (ii) Brake shoe of Railway Wagon (Cast Iron 15 kg.) (iii) MS plate of 250 x 250 x 100 mm size. (iv) Shovel Teeth and spikes. Material Carbon Steel Size Typical	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) Page 52 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	(v) MS round bar of 50 kg with L/D ratio not exceeding 5. 2.3.0 Control Inline Magnetic Separator / Suspended Magnet Local and remote 2.4.0 Electric Supply 415V, 3 phase, 50 Hz input Silicon Rectifier units 2.5.0 Location of silicon rectifier unit Nearby control/MCC room 2.6.0 Handling Arrangement for inline Magnetic separator/Suspended magnet (a) Height adjustment With turn buckle arrangement (b) Cross-travel Electric Hoist operated cross travel facility.		
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) Page 53 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET: LIMESTONE SAMPLING UNIT 1.0.0 GENERAL 1.1.0 Type Automatic 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Codes & Standard ASTM C-50 2.2.0 Uncrushed feed limestone size (-) 250 mm 2.3.0 Crushed feed limestone size (-) 20 mm 3.0.0 CHUTES 3.3.1 Min. angle 60 deg 3.3.2 Cross section Square/rectangular with rounded corners. 3.3.3 Joints Bolted flanges with 6 mm thick standard grade neoprene gasket. 4.0.0 CRUSHER 4.4.1 Uncrushed (as received) feed limestone size (-)250 mm 4.4.2 Crushed (as fired) feed limestone size (-) 20 mm 4.4.3 Output size ASTM C-50 4.4.3 Stages of size reduction Single stage crushing 5.0.0 BELT FEEDER 5.5.1 Belt Flanged type, FR grade 5.5.2 Pulleys Rubber lagged head pulley 5.5.3 Drive Electric Motor	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) Page 55 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET – PADDLE FEEDER 1.00.00 GENERAL 1.01.00 Type of paddle feeder Mobile, Rotary plough 1.02.00 Input limestone parameters As described elsewhere in the specification 1.03.00 Location Underground below ground hopper (Limestone storage shed) 2.00.00 DESIGN & CONSTRUCTION 2.01.00 Paddle Wheel 2.01.01 No. of paddle wheel vanes Suitable 2.01.02 Material for Vane liners TISCRA / SAILHARD / LSLAS07 (Replaceable) 2.02.00 Drive Arrangement 2.02.01 Paddle Wheel Step less Hydraulic drive 2.02.02 Feeder Carriage & flexible coupling Electric Motor with gear box OR Hydraulic Drive OR Electric geared Motor 2.02.03 Minimum No. of starts per hour for drive chain equipment 15 Starts/hour (with minimum 10 consecutive starts) 2.02.04 Paddle wheel speeds Step less variable 2.03.00 Paddle Feeder Rails 2.03.01 Size 90 lb/yd 2.03.02 Support Arrangement To be mounted on supporting structure of conveyors with continuous support below rail. 2.04.00 Feeder Carriage wheels (i) Nos. Suitable (ii) Type Double Flange (iii) Bearings Sealed type 2.05.00 Anti Collision Device Mechanical and Infra red type 2.06.00 Cable Tray Height & width Min. 300 mm above floor & 300 mm wide all along the length of storage shed hopper on both sides.	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) Page 56 of 74

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.07.00	Control	Local	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.CS-0011-109(4)-9 SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) Page 57 of 74
2.07.01	Location of Control Panel	On the feeder carriage	
2.08.00	Idlers for conveyor Belt	As per relevant Sub-section for Belt conveyor system	
2.08.01	Spacing of carrying idlers in the loading zone of paddle feeders	600 mm (maximum)	
2.09.00	Chute work and hopper	20 mm thick TISCRAI / SAILHARD / LSLAS07	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DATA SHEET – LIMESTONE CRUSHER 1.0.0 GENERAL 1.1.0 Type Hammer Mill type crusher 1.3.0 Material to handle Limestone 1.4.0 Feed Size (-) 250 mm, occasionally 1-2% of 400mm size 1.5.0 Product size To suit limestone pulverizer and system , minimum 90% 1.6.0 Input limestone parameters As specified elsewhere 1.7.0 Limestone feeding arrangement Through vibrating screen feeder (However the crusher hall be designed/sized considering zero passage of limestone through screen). 2.0.0 DESIGN AND CONSTRUCTION 2.1.0 Drive arrangement Electric motor, scoop type hydraulic coupling, gearbox. 2.2.0 Rotor Balancing Static 2.3.0 Type of sealing Labyrinth, dust tight arrangement 2.4.0 Type of bearings Spherical roller 2.5.0 Lubrication Manual through grease gun OR with recommended grade of oil in which case the Plummer block shall be designed with oil filling, oil draining and visual oil checking facilities 2.6.0 Tramp collection Required 2.7.0 Output size adjustment facility Required 2.8.0 Top cover of crushers Hydraulically operated 3.0.0 MATERIAL OF CONSTRUCTION 3.1.0 Rotor Shaft Forged steel 3.2.0 Hammer heads Wear resistant cast alloy steel 3.3.0 Hammer arm Forged alloy steel 3.4.0 Housing/frame Steel as per IS:2062 3.5.0 Breaking blocks Cast steel/MS fabricated 3.6.0 Liners (a) Material Suitable for duty requirement (b) thickness As required	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.0.00	OPERATION AND CONTROLS			
3.2.00	3.01.00 This section is intended to cover control/instrumentation and operational philosophy as specified hereinafter complete in all respects, required for Lime stone and Gypsum handling facilities under subject package.			
3.3.00	General Requirements The instruments and controls to be furnished and erected under this specification are as required for safe and satisfactory operation of the Lime Handling System, as outlined under mechanical section and as specified elsewhere in the specification. For the equipment and materials procured by the Contractor from his sub-vendors, the Contractor shall study the specification, safety requirements, interface drawings for such equipment and material in detail and shall coordinate his work with his sub vendors and FGD DDCMIS system and supply instrumentation and control to suit the actual Lime stone and Gypsum Handling equipment.			
3.3.1	Standards / Codes All construction, installation, workmanship, design & equipment shall conform to acts, rules & regulations of the jurisdiction within which the project is to be located, and to the current edition of the following or equivalent standards or codes, in so far as they apply : American Iron & Steel Institute (AISI) American Society for Mech. Engineers (ASME) American Society for Testing & Materials (ASTM) American Wire Gauge (AWG) Institute of Electrical & Electronic Engrs. (IEEE) Instrument society of America (ISA) National Electrical Code (NEC) National Electrical Manufacturers Association (NEMA) United States of America standards (USAS) Bureau of Indian Standards (BIS) Conveyor Equipment Manufacturers Association (CEMA)			
3.03.00	This Sub-section shall be read in conjunction with Electrical Sub-sections.			
3.04.00	General Construction and Design			
3.04.01	General Construction Control desks/panels and annunciation system shall be as per the requirement of electrical Section. Annunciations, indications, electrical meters and instrumentation shall be provided as specified.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.02	Design The complete lime handling plant shall be controlled from FGD DDCMIS system as detailed elsewhere. Also refer other clauses of this chapter. The Contractor shall provide a comprehensive control indication and annunciation scheme. Contractor shall furnish block diagram and write-up on the scheme proposed. The final scheme will be approved by the Employer. In general, interlocking shall be achieved through feed-back signals from field equipment. Comprehensive Annunciation and Indication scheme shall be provided such that, it will be possible for the operator to locate and identify the fault from the face of DDCMIS/LVS/Control-Panel/ TFT itself. The scheme shall include the basic remote control instrumentation, indication and annunciation requirements as per various technical specification requirements. However, the Contractor may offer any alternative proposal which he considers to be equal, superior to the scheme as described in subsequent clauses below for achieving reliable and trouble free operation of the plant, for consideration of the employer.			
4.00.00	OPERATION AND CONTROL PHILOSOPHY The lime handling system shall be controlled from the following control points.			
4.01.00	Coal Handling Plant Main Control Room Overall, operation of the following equipment of Lime Handling Plant shall be controlled from the main FGD control room through FGD DDCMIS being provided by the Contractor. (a.) Conveyors, feeders, flap gates, R & P gates, crushers, hydraulic scoop couplings. (b.) Complete Dust Suppression system, service water system, cooling water system & potable water system. (c.) Ventilation system (group/individual control as required). (d.) In line Magnetic separators and Suspended Magnet (ON/OFF control with indication). (e.) Metal Detectors (ON/OFF control with indication). (f.) Lime Sampling Units. (g.) Belt weigher (ON/OFF control with indication) (h.) Mobile trippers over bunkers/ storage shed (tripper position indications). (j) Paddle feeder (running status with stop facilities).			
4.02.00	Local Control Panels Local control stations for following equipment's shall be provided (a) Paddle feeders along with its dust extraction system (b) Mobile trippers over bunkers/ storage shed (c) Belt Weighers (d) Metal detectors			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(e) Electric hoist - wall mounted control box with pendent push button controls. (f) In line magnetic separators (g) Suspended Magnet (h) Sump Pump (i) Hydraulic scoop coupling. (j) Lime Sampling Sytem:- Complete PLC along with interface with FGD DDCMIS All the above local control panels shall be accessible and located near their respective equipment and shall be complete with all the required controls, interlocks, annunciation's etc. However, for items (j.), above, controls shall be through contractor's PLC. Further, necessary controls, indications and annunciations for all the above equipment shall also be provided at main FGD Control Room as described under relevant clause.			
4.03.01	System Operation			
4.03.01	Lime conveying facilities under subject package shall be operated in association with a coal handling plant being provided by contractor separately. The lime handling plant being provided by bidder envisages control of complete lime handling system including facilities under subject package by DDCMIS. Envisaged Operation philosophy of the plant, in general, shall be as elaborated below: (a.) Lime flow path selection shall be done from CRT/Keyboard to select any one of the following conveying paths. a. Track hopper to Limestone storage shed b. Wagon Tippler to Limestone storage shed c. Limestone storage shed to Limestone bunker d. Combination of above The lime handling system operator will select any one of the above paths from OWS located on the main control desk. The flow stream path is then selected by positioning different flap gates/ movable discharge pulley at desired positions by means of keyboard available at the central control desk. Once the system is in the operation, the gates/ movable discharge pulley can not be moved from their positions and path. Flap gates which do not come in the stream in which coal flow is taking place, can be operated at any time. However, for the flap gates in Limestone bunker area conveyors, it shall be possible to change flap gate position while the conveyor is in operation and feeding coal using interlock bypass facility, provided that sequential permissive are available. The Control system will be designed for "Auto" & "Manual" operation of the conveyors in the selected path. Auto/Manual Selection shall be done from keyboard.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.06.00	Auto Mode : In the “Auto” mode, the conveyors and related equipment will start sequentially when the “System Start” is activated. During stopping, when the “System Stop” is activated, all conveyors will also stop sequentially (in the reverse sequence) allowing time delays for clearing the belts. Manual Mode : In Manual Mode, the operator will start the conveyor system, in the same sequence as in Auto mode from keyboard. The operator will also stop the conveyor system, by pressing "System stop" or individual “Stop” push buttons/command from keyboard in the reverse sequence. During “Sequence Start” in both Auto and Manual modes, first the required number of hooters (3 phase induction motor type) will be energized simultaneously for a preset time of 1 minute or so (adjustable at site) as per the program. After the preset time, the hooters will stop and a preset time of two minutes (adjustable at site) as per program will be allowed for the movement of the personnel and for the permissive of the conveyor system operation. This condition will be indicated on the panel by glowing of lamp “Lime Handling Sequence Start”. The starting permissive will be available for a period of 5 minutes (Pre-programmed and adjustable in the field). In the event the last conveyor / equipment is not started within this preset time of 5 minutes, the start command for equipment not started will be withdrawn. The system cannot be started again unless the “Sequence Start” push button is again pressed and the hooters sound again, as described before. Those conveyors and equipment, which have already started, will continue to run. The status indication in the graphic display against all conveyors and equipment in the selected path/stream will start slow flickering. However, all status indications against all flap gates / movable discharge pulley in the selected path will glow steadily. Therefore, from the selected flow stream path of the flap gates / movable discharge pulley, the operator will come to know the conveyors and equipment to be started for the selected path/stream. After a conveyor/equipment is started, the status indications against that conveyor / equipment will change to steady glow indicating that it is running. Separate color scheme shall be provided to all common conveyors and equipment, to distinguish handling of Lime and Coal while conveying Graphic display status indicators associated with a particular motor/equipment shall flicker fast in case of fault / trip. In addition, emergency stop push button on the control desk for immediate shut down of complete plant shall be provided. For changeover of feed from one row of Bunkers to another row of Bunkers without stopping of the LHP, provision shall be made for interlock bypass on the control desk for flap gates of all conveyors in Boiler area for a preset period. If the changeover, in above specified time, is not completed then the entire LHP shall stop. (i) Lamp test facility will be provided for the annunciation and mimic lamps.			
	Conveyor System (a) Normally the movement of the paddle feeders feeding Lime from the Limestone shed to the conveyor shall be controlled from the paddle feeder itself based on instructions from main control room. (b) The paddle feeder carriages shall move continuously to and fro along their tracks. Suitable limit switches and anti-collision devices (both mechanical limit switch operated and infra- red type) shall be provided to enable them to change direction of movement as soon as they come within a specified distance at the end of travel in one direction.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c) The operation and stoppage of the paddle feeders shall be signaled in the main control room of the Lime handling plant. It shall be possible to stop the paddle feeder from main control room. It shall be possible to stop the conveyor taking feed from paddle feeder from respective paddle feeder. (d) Each conveyor shall be protected against damage to the edge of the belt due to excessive sideways movement by providing an adequate number of belt sway switches. In addition, each conveyor shall be provided with one (1) No. speed detection device (zero speed switch). The zero speed switches shall be designed to sense belt speed. In case of speed of belt goes below 85% of rated speed, it shall trip the conveyor. (e) All the conveyors shall be protected from reverse running due to power failure by providing mechanical or electrical locking system. (f) The starting sequence of the conveyors shall follow a direction opposite to that of flow of material i.e. : (1.) In case of direct conveying of lime to limestone bunkers, start from lime bunker conveyor and end up with reclaim conveyors below track hopper/Wagon Tippler . (2.) In case of stacking of lime in stock yard, start from yard conveyor and end up with reclaim conveyors below track hopper/Wagon Tippler. (3.) In case of reclamation of lime from stock yard, start from bunker conveyors and end up with yard conveyor alongwith Travelling tripper. (4) The starting of mobile trippers shall be interlocked with operation of the bunker bay conveyors. (g) Any individual equipment (belt conveyor etc.) should not be allowed to start unless the equipment immediately following the same in the direction of flow of material is already in operation. (h) Stop/tripping of any equipment from running condition shall trip all preceding equipment in the system, except crushers but shall not effect succeeding ones which shall continue to operate. (i) Adequate number of pull-cord switches shall be provided at suitable intervals along the length of each belt conveyor, which shall enable the respective conveyor to be stopped immediately. Each pull chord switch shall be identified by a specific number on HMI in the main control room. Each belt sway switch shall also be identified by a specific number on HMI in control room. (j) Means shall be provided to pre-warn personnel working nearby when starting any conveyor and mobile tripper. (k) Interlocking of various conveyors shall be achieved with Flap Gate, discharge pulleys, limit switches and zero speed switches. (l) Suitable indication for paddle wheel rpm shall be provided on the local panels. Manual facility to control the cutting rate of paddle feeder shall also be provided. (m) Motors shall start only when the brake/rail clamp if-provided, is in “not applied” condition. This signal shall be obtained from limit switch provided for that purpose.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.07.00	(n) Lime stone crusher shall be provided with speed and vibration monitoring instruments. crusher shall trip in case speed/ vibration is going beyond tolerable limits of design. Temperature sensing devices shall be installed on all bearings of each of the ring granulator to trip the ring granulator in case of temperature goes beyond limit. Audio-visual annunciation shall be provided in main control room and locally also. (o) Once a conveyor trips, flap gate directing coal from this conveyor shall change over its position with a time delay and shall come back to the original position again. This is to prevent jamming of gate. (p) Tripping of the respective conveyor shall be provided in case any of paddle feeders and mobile trippers starts running along with conveyor belt at speed higher than their rated speed by providing an over speed sensing device on the equipment. (q) It shall be possible to trip bunker conveyor from mobile tripper Where ever scoop type coupling provided for HT motors, the coasting time of respective conveyor, thruster brake, actuator selection and the chute size shall be so selected such that there is no spillage of coal from any down stream conveyors during next start. (r) Wherever the conveyor is provided with the movable discharge pulleys in place of flap gates, the starting of the conveyor will be interlocked with the position of the movable discharge pulley.			
	Interlocking (a.) The following conveyors / equipment will come under interlock scheme :- (1) All conveyors (2) All flap gates (3) Mobile Trippers (4) Rack & Pinion Gates (5) Metal detectors (6) Magnetic Separators and suspended Magnet (7) Crushers (8) Paddle Feeders (9) Belt scale (b.) The following equipment will not come under interlock of the conveyor scheme. (1.) All dust extraction systems & service water system. (2.) Ventilation systems (c.) All conveyors and equipment will have local push button stations each consisting of : (1.) Pos - I, Pos - II & stop button for flap gate. (2.) Emergency stop push button (Red) for other equipment			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(d.) Belt scale shall be started when relevant conveyors are started (e.) The dust extraction systems will be energized as soon as the conveyors are energized. (f.) Lime handling plant shall be tripped in case of detection of fire. (g.) Interlock for H.T. Motor : H.T. motors used will continue to run on no load by disengaging the fluid coupling in case of failure of any process interlock. The H.T. motors will however be tripped in case of any motor fault like O/L, high motor winding temperature etc. In addition, in case of normal stop command, after running of the system, motors will stop. (h.) The following are the various safety interlocks for the conveyors and other equipment. This list is indicative only and the Contractor shall develop a comprehensive interlocking scheme. Conveyors a) Pull - Chord switch - not operated b) Belt sway switch - not operated c) Under speed switch - closed at 90% speed of the conveyor within designed accelerating time. d) Motor protection - not tripped e) Local stop PB – reset f) Chute Block switch - not operated. g) Brakes for conveyor – not operated. h) Trip circuits healthy. i) Temp. of fluid coupling oil - not high Paddle Feeders a). Motor O/L - not tripped b). Local E-Stop PB - reset c). Stop PB in main FGD control room - reset d). All Limit Switches – reset e). Overspeed limit switch – not tripped Travelling Tripper : a) Stop PB in Local control station - reset b) Motor O/L not tripped. c) Over Travel Limit switches - not tripped.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Magnetic Separators / Metal Detectors / Suspended Magnets a) O/L / fault relay - not tripped. b) Stop PB (Local & Remote) reset. c) Metal detector reset d) Oil temperature - not high Flap Gates/ R & P Gates a) End of travel limit switches - reset. b) Torque limit switches - reset. c) Local stop - reset. Crusher a) Zero speed - not operated b) Temp. of fluid coupling oil - not high. c) Local stop push button reset. d) Temperature of bearings – not high. e) Cooling water flow switch – reset Motor O/L – not tripped Local E-Stop PB-reset Stop PB in main FGD Control Room reset. All limit switches - reset All limit Switches – not tripped. Apron feeder Motor O/L – not tripped. Local stop PB – reset			
4.07.01	The lists of indications and audio-visual annunciation given in subsequent clauses are indicative only and the same shall be finalised during detail engineering.			
4.07.02	Status indications in Large Video Screen Following individual status indications shall be provided in LVS with individual ON/OFF/TRIP indications on CRT. (a.) Conveyor 'ON' (b.) Flap Gate Rack and Pinion.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.08.00	(c.) Belt scale flow rate indication and totalizer. (d.) Belt sway switch operated for each conveyor (individual switch indication on CRT). (e.) Pull cord switch operated for each conveyor (Individual switches indication on CRT). (f.) Zero speed switch operated for each conveyor (g.) Paddle Feeder "ON (h.) Travelling tripper position." (i.) Crusher ON (j.) MD/ ILMS/ SM/ LSU ON (k.) DE/ SW/PW/CW/Vent ON (System wise) (l.) Unit wise MW indication, total lime flow & Bunker level. (m.) Further Mimic lamps for HT and LT SLDs shall be provided on the control desk.			
	Annunciation System: 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. Wherever group annunciation is provided, alarm status of individual equipment shall be provided on OWS. (a) 3.3 kV Breaker Trip (Group wise for each board) (b) 415 V MCC Breaker Trip (MCC wise) (c) Bus under voltage for each LT MCC & HT switchgear buses. (d) Following group wise annunciation shall be provided for transformers : (1.) Buchholz alarm (2.) Winding/oil temperature high alarm (3.) Oil level low alarm (4.) Buchholz trip (5.) Winding/oil temperature high trip (e) A.C Control Supply failure. (f) D.C. Control Supply failure. (g) Annunciation supply failure. (h) Both CPU fail (i) Stand by CPU in service (j) H.T. motor overload alarm (individual)			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(k) HT motor bearing/ winding temp. high alarm (for each) and trip (for each) (l) HT motor trip on electrical fault (for each) (m) LT motor overload tripped (for each). (n) Belt sway switch operated (for each) (o) Pull cord switch operated (for each) (p) Zero speed switch operated. (for each) (q) Chute plugged (for each) (r) Paddle feeder over speed tripped (group) (s) Tripper over speed tripped (for each) (t) Magnetic separator fault and cleaning belt trip. (u) (i) Metal Detector fault (for each) (ii) Metal detected / MD not reset (for each) (v) Belt Scale fault (for each) (w) Sampling system faults and trips (for each) (x) Crusher low speed & crusher bearing temperature – high. (y) Water level low in tanks (for each) (z) Oil temperature of fluid coupling high (aa)Dust Extraction/service water system faults and trips (system wise) (bb)20% spare window For identification of the fault for a particular conveyor or equipment, status indication against that conveyor / equipment in the mimic will start fast flickering and the annunciation window will be blinking against that particular fault. In addition, a buzzer (alarm) will start sounding. After acknowledgement of the fault, the buzzer will stop, but the fast flickering on the mimic and the steady glow on the annunciation window will continue until the fault is cleared and the Reset push button is pressed. When the fault is cleared and the Reset push button is pressed, the status indication of that conveyor / equipment on the mimic will start slow blinking if it is on selected path otherwise it will go off and the steady glow in the annunciation window will go off. However, pressing of the Reset push button before clearance of the fault, will have no effect on the lamps. At the time of a fault, the faulty conveyor / equipment, as well as the preceding conveyors / equipment in the interlock sequence, will stop except H.T. motors for which only scoop coupling will be disengaged and motor will continue to run for process fault. In case of motor fault, H.T. motor will trip but the succeeding conveyors / equipment will continue to run. The status indication against the preceding conveyors / equipment will start slow blinking while the faulty conveyor / equipment will be fast blinking. Start command shall not be initiated unless reset button in pressed after clearance of fault.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	The sequence of operation of the annunciation system shall be as follows :-			
	CONDITION		STATUS	
	Normal :	Ann. Window	:	Off.
		Status indication	:	Steady glow
		Buzzer	:	Off.
		:		
	Fault :	Ann. Window	:	Blinking.
		Status indication	:	Fast blinking
		Buzzer	:	Sounding.
		:		
	Press Accept. PB.	Ann. Window	:	Steady glow.
		Status indication	:	Fast blinking
		Buzzer	:	Off.
	Press Reset PB	Ann. Window	:	Off.
	(When			
	fault is cleared):	Status indication	:	i) Steady blinking (if on selected path)
				ii) Off (if not on selected path)
		Buzzer.	:	Off.
4.09.00	Dust Extraction System			
	Complete interlock, protection, annunciation for Dust Extraction System to be provided by the contractor and the same shall be approved by Employer during detail engineering.			
4.10.00	Metal detectors			
	(a) It shall be possible to start the conveyors only after energizing the metal detector and ‘Metal detector reset’ condition. Once the metal is detected, the corresponding conveyor shall trip.			
	It shall be possible to restart the conveyors, after local resetting of metal detector and putting back the marker bag in position. Metal detector ON/OFF push buttons shall be provided in main control room also.			
	(b) In case of tripping of conveyor system, metal-detector shall get de-energized after a time lag.			
(c)	Following individual indications shall be provided on local control panel.			
(1)	Metal detector ‘ON’			
(2)	Metal detected			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
(3)	Metal detector 'reset'.			
(4)	Metal detector faulty.			
4.11.00	Sump Pumps (a) Sump Pumps shall start and stop by the level switches in the sump automatically. Further manual override start / stop push button shall be provided locally on ground level. (b) Any of the pumps can be selected as auto-standby. (c) If the sump level continues to be high even after the first pump is under operation second pump shall start automatically. (d) The following indications for sump pumps shall be provided on local Control Panel. (1.) Water level high (2.) Motor ON/OFF/TRIP.			
4.12.00	Lime Sampling system (a) Lime Sampling Unit shall be controlled through PLC as per standard and proven practices of LSU equipment / LHP supplier, which will be located in the nearest MCC. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Suitable Local Operation shall be provided for LSU. (b) Lime Sampling Unit shall be interfaced (Soft and Hardwired Interface) with main FGD DDCMIS for complete control and monitoring of LSU system. Mimic shall be provided in the Operator Work Station (OWS) at main FGD control room. (c) Only one start/stop push button along with selector switches for various modes of operation of Lime sampling system shall be provided for automatic operation of complete lime sampling system. This control facility shall be provided at main FGD control desk as well as locally. In any case, local push button stations shall be provided for all individual equipment of lime sampling system near the equipment. (d) All necessary automatic controls shall be provided for meeting the requirements of ASTM-D-2234 or ASTM-C-50. (e) Following indications shall be provided on local control panel (1.) System ON/OFF/TRIP (2.) Primary cutter stuck up between parking positions. (f) In case of primary cutter getting stuck between parking positions, preceding conveyor shall trip and annunciation shall appear at Main FGD Control room. (f) There shall be protection in the primary coal sampler to trip the conveyor belt in case primary sampler falls on running conveyor due to coupling failure etc. (g) Necessary interface signals e.g. LSU system status, cutter stuck etc shall be provided at main FGD control room.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.13.00	Paddle Feeders			
	Paddle feeders shall be controlled from the local control panel suitably mounted on the unit. Requirement of operation as described else where in the specification shall be complied with. Following indications shall also be provided on the local control panel: (a.) Motor ON/OFF (b.) Motor O/L protection operated (c.) Brakes applied (if provided) (d.) “Digital pressure indications of Hydraulic Power pack including those of hydraulic pump discharge, return (leakage) traverse pump discharge (forward and reverse) oil line.” (e.) Coal flow rate Main Hydraulic pressure of paddle feeder wheel drive system to be reduced to minimum through its control circuit during each tripping of main drive motor.			
4.14.00	Travelling Trippers			
	(a) Mobile tripper unit shall be locally controlled from the operating platform suitably located with the unit as per instructions given from main FGD control room. (b) End travel limit switches shall also be provided. (c) Travel drive motor shall start only when brake and rail clamps are in disengaged condition. (d) It shall be possible to trip the bunker Conveyors from tripper. (e) When the last bunker is full, it shall not be possible to change over the tripper flap gate from bunker feeding position to last bunker feeding position. (f) As soon as the bunker conveyor trips, tripper flap gate shall change over its position after a time lag. (g) Two nos. emergency stop button one on each side shall be provided on tripper to stop the machine at any position. The control unit on tripper shall be provided with start / stop push button and indication lamp for travel / gate. The tripper brakes and rail clamps shall be energised (and released) when the tripper motors are ON and the brakes will be applied when the travel motors are OFF. Two travel limit switches shall be provided at either end of tripper carriage for limiting the travel drive between two ends of the track. The first one shall be normal limit and the second one for over travel limit. In addition to above, position indication for bunker position of tripper will be provided in Main control room. Necessary position encoders/limit switches shall be provided. (h) Following individual indications shall be provided on local control panel (1.) Motor ON/OFF/TRIP (2.) Brakes applied			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.15.00	(3.)	Rail clamps applied		
	(4.)	Flap gate position		
	(i)	Indication of tripper flap gate positions shall be given in the main FGD control room.		
	(j)	Chute blockage switch shall be provided at each leg of chute and shall trip the tripper conveyor in case of blockage.		
4.16.00	Flap Gates/ R&P Gates All Flap Gates/ R&P Gates shall be motorised with remote controlled from the main control desk. Their position shall be indicated on the mimic of main control room.			
4.17.00	Belt Weighers Each belt scale shall give output to DDCMIS for display of flow rate indicator and totalizer on TFT and print out at main FGD control room. Each belt scale shall also have rate flow indicator and totaliser mounted near the unit.			
4.18.00	Magnetic separator / Suspended Magnet It shall be possible to start the conveyor only after energising the magnet of ILMS or SM. Further, if conveyor system trips magnetic separators shall get de-energised after a time lag and suspended magnet will remain energised and can be de-energised locally. Also if drive motor of cleated belt of ILMS trips, magnetic separator shall not get de-energised, but conveyor system shall trip and audio-visual annunciation shall appear at main FGD control room. Following individual indications shall be provided on local control panel (a.) Magnetic separator ON. (b.) Incoming supply ON (c.) 'Under current relay' operated (d.) Cleated belt motor ON/OFF/TRIP (e.) Oil temperature high			
	Service water, Cooling Water and potable water pumps (a) These pumps shall be started from main FGD control room (b) Pump shall trip in case of low water level in tank. (c) Following individual inputs shall also be provided to DDCMIS system for alarms/indications : (1.) Motor ON/OFF/TRIP (2.) Discharge water pressure low (3.) Water level low in tank			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(4) Water level high in tank Contractor shall provide a comprehensive interlock and protection scheme and include a block logic diagram and write up on the scheme proposed. The final scheme shall be subject to approval of Employer. Sequential interlocking as applicable shall be provided. This shall be a part of main interlock scheme /writeup for the entire Lime Handling Plant.			
4.21.00	Summary of control philosophy Contractor shall furnish summary of control philosophy indicating permissive, trip and interlock conditions for each drive/equipment. It shall clearly list all permissive conditions (conditions required to start the drive), all the trip/protection conditions and each auto start/open and auto stop/close condition for each drive/equipment. The sequential start-up and shut-down steps for a group of drive/equipments shall also be described clearly. The above summary conditions shall be comprehensive to include all process conditions and shall be elaborated in clear and unambiguous way, and shall include tag numbers of devices and equipments. A centralized main FGD control room (DDCIMS based) shall be provided to control and monitor the operations of the Lime handling system and Gypsum handling plant.			
4.22.00	<u>Logic Diagram</u> The contractor shall furnish comprehensive logic diagram showing all interlock, protection, sequence and alarm requirements of complete system to the employer during detail engineering stage. In this logic diagram, tag number corresponding to I/O list and drive list shall be clearly indicated. The format of this logic diagram shall be informed by employer during detail engineering. The recommended logic and write-up shall match fully.			
4.23.00	Crushed Lime Stone Storage Silo: The crushed lime stone storage silo shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete conical portion to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 (part 1 of 3). Silo is to be provided with discharge at the bottom with vibratory feeders. Each silo to be fitted with steel legs, fences, side ladders and operating platforms. Each silo is required to equipped with following: level switches, dust collectors with bag filters and dust rapping mechanism, air flow pads for aeration/air blast of material, vent fan with filters, manual, pneumatic or electrically operated valve as per proven design criterion of silos and pressure relief valve settled at pre-determined relief pressure to avoid pressuring of silo at various operating conditions. Capacity as indicated are minimum. Each Silo is to be designed for 7 days retaining capacity of material with adequate air space with maximum capacity limitation up to 2000MT .			
4.19.18	TRUCK TIPPLER: A. The Hydraulic truck tippler shall consist of heavy duty steel fabricated frame with anti-skid chequered plate welded on it, pair of heavy duty hydraulic cylinder for lifting, overturning arrestor, a pair of back stopper and mechanical locking arrangement. B. The hydraulic power pack shall be totally enclosed and consist of hydraulic gear pump, electric motor with starter panel, hydraulic oil tank, control valves, high pressure pipe lines and hoses, control panel fitted with push button switches etc. C. Capacity:60T			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	D. Unloading Cycle: 3-4 minutes or as suited to reach the capacity of 150TPH. E. Max tilting Angle:55 Degree F. Main Structures: Steel IS 2062/IS 1570 G. Hydraulic Cylinder Tubes: Honed/Roller burnished of seamless H. Hydraulic Cylinder Piston Rod:C45/EN8 I. Seal and guide ring:PTFE		
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SUB-SECTION-I-M7

PIPING

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																					
	<u>LOW PRESSURE PIPING</u>																																								
1.00.00	EQUIPMENT SIZING CRITERIA																																								
1.01.00	All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.																																								
1.02.00	For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.																																								
1.03.00	Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following: a) Water Application <table><thead><tr><th colspan="2"></th><th colspan="3">Water Velocity in m/sec</th></tr><tr><th></th><th>Pipe Size</th><th>Below 50 mm</th><th>50-150 mm</th><th>200 mm & above</th></tr></thead><tbody><tr><td>(a)</td><td>Pump suction</td><td>-----</td><td>1.2-1.5</td><td>1.2-1.8</td></tr><tr><td>(b)</td><td>Pump discharge and recirculation</td><td>1.2-1.8</td><td>1.8-2.4</td><td>2.1-2.5</td></tr><tr><td>(c)</td><td>Header</td><td>-----</td><td>1.5-2.4</td><td>2.1-2.4</td></tr></tbody></table> Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec. WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value: <table><tbody><tr><td>(i)</td><td>Carbon steel pipe</td><td>100</td></tr><tr><td>(ii)</td><td>Ductile Iron.</td><td>140</td></tr><tr><td>(iii)</td><td>Rubber lined steel pipe</td><td>120</td></tr><tr><td>(iv)</td><td>Stainless steel pipe</td><td>100</td></tr></tbody></table> For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water. (b) Compressed Air Application Compressed air						Water Velocity in m/sec				Pipe Size	Below 50 mm	50-150 mm	200 mm & above	(a)	Pump suction	-----	1.2-1.5	1.2-1.8	(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5	(c)	Header	-----	1.5-2.4	2.1-2.4	(i)	Carbon steel pipe	100	(ii)	Ductile Iron.	140	(iii)	Rubber lined steel pipe	120	(iv)	Stainless steel pipe	100
		Water Velocity in m/sec																																							
	Pipe Size	Below 50 mm	50-150 mm	200 mm & above																																					
(a)	Pump suction	-----	1.2-1.5	1.2-1.8																																					
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5																																					
(c)	Header	-----	1.5-2.4	2.1-2.4																																					
(i)	Carbon steel pipe	100																																							
(ii)	Ductile Iron.	140																																							
(iii)	Rubber lined steel pipe	120																																							
(iv)	Stainless steel pipe	100																																							

CLAUSE NO.	TECHNICAL REQUIREMENTS						
1.04.00	The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.						
1.05.00	Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.						
1.06.00	Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).						
1.07.00	Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.						
1.08.00	High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.						
1.09.00	Material of construction for pipes carrying various fluids shall be as specified elsewhere.						
1.10.00	Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.						
1.11.00	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.						
1.12.00	Threaded joints shall be provided with Teflon sealant tapes.						
1.13.00	Following types of valves shall be used for the system/service indicated.						
	SYSTEM	TYPES OF VALVES					
		Butterfly	Gate	Globe	Check	Ball	Plug
	Water	x	x	x	x	x	
	Air		x	x	x	x	
	Drains & vents		x	x	x		
	Fuel oil (if any)		x	x	x	x	x
1.14.0	Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.						
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.00.00	TECHNICAL SPECIFICATION			
2.01.00	GENERAL			
	Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.			
2.02.00	Pipes and fittings			
2.02.01	All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.			
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.			
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.			
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).			
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.			
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.			
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.			
2.02.08	For rubber lined ERW pipes, beads shall be removed for pipe size 80 NB and above.			
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.			
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2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.															
2.02.11	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.															
	Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.															
2.03.00	Material															
2.03.01	Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.															
2.03.02	No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.															
2.03.03	All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.															
2.03.04	All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.															
2.03.05	Material of construction for pipes carrying various fluids shall be as follows:															
	<table><tr><th>Sl N</th><th>Type of Fluid</th><th>Material</th></tr><tr><td>1.</td><td>i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)</td><td>IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.</td></tr><tr><td>2.</td><td>i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)</td><td>Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below</td></tr><tr><td>3.</td><td>i) Drinking (potable) water ii)Compressed air (Instrument & service air)</td><td>ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.</td></tr></table>				Sl N	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below	3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
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2.03.06	In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralized water, drinking water .															
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2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).			
2.03.08	In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.			
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).			
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.			
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.			
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.			
2.04.00	Field routed pipes:			
2.04.01	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval.			
2.05.00	Slope/Drains and Vents			
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.05.02	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.			
2.06.00	Pipe Joints In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.			
2.06.01	Screwed Joints (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/ ANSI B1.20.1 (taper) NPT  IS: 554 unless specified otherwise. (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test. (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately. (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing. (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.			
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2.06.02	Welded Joints (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.			
2.06.03	Flanged Joints (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only. (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification. (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.			
2.07.00	Bends/elbows/mitre bends/ Tees/ Reducers & other fittings			
2.07.01	For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11. Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1). However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.			
2.07.02	For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. However, mitre bends are also acceptable for rubber lined pipes above 1200 NB. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.			
2.07.03	For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.			
2.07.04	Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.			
2.07.07	In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.			
2.08.00	Flanges			
2.08.01	Flanges shall be slip on type or weld neck type. Welding of flanges in tension is not permitted.			
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2.08.02	All flanges and-flanged drilling shall be to ANSI B 16.5 / BS EN-1092 / AWWA C - 207 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.			
2.09.00	Specific technical requirement of laying buried pipe with anti-corrosive treatment The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.			
2.09.01	Trenching (a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.			
2.09.02	Preparation and cleaning of piping (a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager. (b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.			
2.09.03	Coating and wrapping/ Anti corrosive Protection Coal tar tape a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are: (1) Coating primer (coal tar primer) (2) Coating enamel (coal tar enamel) (3) Wrapping materials. All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable. Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat. Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available. Total thickness of completed coating and wrapping shall not be less than 4.0 mm. b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar			
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	primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm minimum.			
2.09.04	Trench bed preparation and back filling Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.			
2.09.05	Laying of galvanized steel (GI) pipes All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste. All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and "anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.			
2.10.00	Cleaning and flushing			
2.10.01	All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.			
2.10.02	Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.			
2.10.03	After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.			
2.10.04	All compressed air pipe work shall be cleaned by blowing compressed air.			
2.11.00	Specification for hangers and supports			
2.11.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.			
2.11.02	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.			
2.11.03	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.			
2.12.00	Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.			
2.12.01	GENERAL (a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.			
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2.12.02	(b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. (c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed. (d) The actuator-operated valves shall be designed on the basis of the following: (1) The internal parts shall be suitable to support the pressure caused by the actuators; (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc. (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also. (4) All actuators operated valves shall open/ close fully within time required by the process. (e) Valves coming under the purview of IBR shall meet IBR requirements. (f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc. (g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer			
	VALVE BODY MATERIAL Valve body material for various services shall be as follows: Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below. For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below. DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable.			
2.12.03	The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
2.12.04	Standards and Codes					
	AWWA-C-504		Rubber seated butterfly valves.			
	BS-5155/EN-593		Cast iron and steel body butterfly valves for general purpose.			
	IS-778		Gun-metal gate, globe and check valves for general purpose.			
	BS-5154		Copper alloy globe/globe stop and check and gate valves for general purpose.			
	IS-780		Sluice valves for water works purpose (50-300 mm size)			
	IS-2906		Sluice valves for water works purpose (350-1200 mm size)			
	IS-5150		Cast iron wedge and double disc gate for general purpose.			
	BS-5152		Specification for cast iron globe valves.			
	BS-5153		Cast iron check valves for general purpose.			
	IS-5312		Swing check type reflux (non-return) valves.			
	ANSI B 16.34		Standard for valves.			
	API-594		Standard for Dual-check valves.			
	API-600		Steel gate valves.			
	ANSI-B-16.10		Valves face to face and other relevant dimension.			
	API-598		Valves inspection test.			
	2.13.00	End Connections				
		The end connections, shall comply with the following:				
		Socket welding (SW) - ANSI B 16.11				
		Butt Welding (BW) - ANSI B 16.25.				
		Threaded (SC) - ANSI B 2.1				
		Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).				
		Gate/Globe/Check Valves				
		(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).				
		(b) All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.				
		LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-0011-109(4)-9		SUB-SECTION-I-M7 (LOW PRESSURE PIPING)

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c) All gun metal body valves shall have screwed ends. (d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints. (e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate. Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items: (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Draining arrangement wherever required. (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle. The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened. (g) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB. (h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type. (k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable. (l) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore. (m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-0011-109(4)-9	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	PAGE 12 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.13.01	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)			
	(a) The materials shall generally comply with the following:			
	(1) Cast Steel Valves			
	Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105		
	Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105		
	Trim.	ASTM A 182 Gr. F6 or Equivalent		
	(2) Stainless steel valves			
	Body & Bonnet	SS 304		
	Disc	-do-		
	Trim.	SS 316		
	(3) Cast iron valves			
	Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260		
	Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay		
	Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260		
	Hinge pin for non-return valves	AISI 316		
	Stem for gate globe valves	13% chromium steel or Equivalent		
Back seat	13 % chromium steel / 13% Chrome overlay			
(4) Gun Metal valves				
Body and bonnet	IS 318 Gr. 2/ Equivalent Standard			
Trim.	-do-			
(b) Cast iron body valves shall have high alloy steel stem and seat.				
(c) Material for counter flanges shall be the same as for the piping.				
(d) Forged carbon steel valves are also acceptable in place of Gun metal valves.				
2.14.00	Air Release Valve			
	(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-0011-109(4)-9	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	PAGE 13 OF 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure. (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass. (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.			
2.15.00	Butterfly valves			
2.15.01	Design/Construction			
	(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. (b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable (c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same. (d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction. Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.			
2.15.02	Material of Construction (Butterfly Valves)			
	Materials and other design details shall be as indicated below :			
	(a) Cast Iron Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated		
	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.		
	Seat ring	18-8 Stainless steel		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.15.03	Seal	Nitrile Rubber		
	(b) Stainless Steel Butterfly Valves			
	Body & Disc	SS 304		
	Shaft	SS 316		
	Seat Rings	EPT/BUNA-N/Neoprene		
	(c) Carbon steel Butterfly Valves			
	Body & Disc	ASTM A 216, Gr. WCB		
	Shaft	SS 304		
	Disc & Seat Rings	EPT/BUNA-N/Neoprene		
	(d) Elastomer lined Butterfly Valves			
Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.			
Shaft	SS 316			
2.15.03	Proof of Design Test (Type Test) for Butterfly Valves			
	Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.			
	All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.			
2.16.00	Float operated valves			
	(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.			
	(b) DESIGN AND CONSTRUCTION FEATURES			
	The following design and construction feature of the valve shall be the minimum acceptable.			
	(c) Valves shall be right-angled or globe pattern.			
	(d) Valves shall be balance piston type with float ball.			
	(e) Leather liner shall not be provided.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-0011-109(4)-9		SUB-SECTION-I-M7 (LOW PRESSURE PIPING)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.17.00	(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats. (g) Valves shall be suitable for flow velocities of 2 to 2.5 m/sec. (h) The valves shall have flanged connections. Surface preparation and Painting for external piping surfaces (non-coastal projects) a) Surface preparation - Power tool cleaning / Shot blasting/ abrasive blasting b) Type of Primer - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 (2 X 25 microns) c) Intermediate Coat – Synthetic Enamel (long oil alkyd) to IS2932 (1 X 30 microns) d) Final Coat - Synthetic Enamel (long oil alkyd) to IS2932 (2 X 35 microns) Min. Total DFT (Microns) to be maintained – 150 (Min) and Color shall be as per NTPC Color Coding Scheme Note: No painting is required on Galvanized, Stainless Steel, Gun Metal surfaces			
	2.18.00	Surface preparation and Painting for external piping surfaces (coastal projects) a) Surface preparation - Near white metal blast cleaning with surface profile 35-50 microns as per surface preparation specification SSPC.SP10 of Society of Protective coatings , USA b) Type of Primer – Inorganic zinc (ethyl) silicate primer coat(1 X 70 microns): Self-curing Inorganic Zinc (ethyl) Silicate Primer Coat (having minimum 80% of metallic Zinc content in dry film , Solid by Volume Minimum 60% ±2%) to be applied over blast cleaned surface. c) Intermediate Coat (2 X 90 microns)– Polyamide Cured pigmented Micaceous Iron Oxide Epoxy based Paint (containing lamellar MIO minimum 30% on pigment, Solid by Volume Minimum 80% ±2%) Polyamide Cured pigmented Micaceous Iron Oxide Epoxy based Paint (containing lamellar MIO minimum 30% on pigment, Solid by Volume Minimum 80% ±2%). d) Final Coat (1 X 70 microns) - Acrylic Aliphatic Polyurethane, two pack, isocyanate based color pigmented Paint (Solid by Volume Minimum 55% ±2%) Min. Total DFT (Microns) to be maintained – 320 (Min) and Color shall be as per NTPC Color Coding Scheme Note: 1.) For external surfaces (galvanized steel), proper surface preparation with power tool cleaning up to grade ST2, ISO:8501-01 followed by zinc phosphate primer with 50 microns DFT, again followed by Acrylic Aliphatic Polyurethane coat of 40 microns DFT. 2.) If final shade of 9002 (off white) is required then Micaceous Iron Oxide (MIO) color shall be grey. 3.) No painting is required on Stainless Steel, Gun Metal surfaces.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-0011-109(4)-9	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	PAGE 16 OF 16

SUB-SECTION-I-M8

MDL

Annexure-A1- Approval n Information category

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
1	011-109(4)-PVC-B-001	-	GA & RCC Detail of Foundation of Reagent Feed Tank	FGD	-	A
2	011-109(4)-PVC-B-005	-	General Arrangement and Load data of Auxiliary Absorbent (Storage) Tank	FGD	-	A
3	011-109(4)-PVC-B-007	-	Geotechnical investigation work: Location of Borehole and other field test	FGD	-	A
4	011-109(4)-PVC-B-014	-	GA & RCC detail of Foundation of Pipe & Cable Rack structure	FGD	-	I
5	011-109(4)-PVC-B-019	-	Architectural dwg of Electrical equipment & control Building-I	FGD	-	A
6	011-109(4)-PVC-B-022	-	Gypsum Dewatering Building : RC Details of Column	FGD	-	I
7	011-109(4)-PVC-B-023	-	Architectural drawing of Gypsum Dewatering Building	FGD	-	A
8	011-109(4)-PVC-B-028	-	GA & RCC Details of Foundation of Ball Mill Building	FGD	-	A
9	011-109(4)-PVC-B-030	-	Ball Mill Building : RC Detail of Column	FGD	-	I
10	011-109(4)-PVC-B-031	-	Architectural drawing of Ball Mill Building	FGD	-	I
11	011-109(4)-PVC-B-034	-	GA & RCC Detail of Foundation of Booster Fan	FGD	-	A
12	011-109(4)-PVC-B-036	-	GA & RCC detail of Foundation of Ball Mill	FGD	-	A
13	011-109(4)-PVC-B-038	-	GA & RCC detail of Foundation of Absorber	FGD	-	A
14	011-109(4)-PVC-B-059	-	Detail civil drawings for Road	FGD	-	I
15	011-109(4)-PVC-B-060	-	Detail civil drawings for Pavement	FGD	-	I
16	011-109(4)-PVC-B-061	-	Detail civil drawings for Drains	FGD	-	I
17	011-109(4)-PVC-B-063	-	ABSORBER LOAD DATA	FGD	-	A
18	011-109(4)-PVC-B-098	-	Detail civil drawing for sewerage system	FGD	-	I
19	011-109(4)-PVC-B-101	-	FGD Wet Stack-General Arrangement of Wet Stack	FGD	-	A
20	011-109(4)-PVC-B-102	-	FGD Wet Stack- Foundation Details including shell dowels & duct pedestals	FGD	-	A
21	011-109(4)-PVC-B-103	-	FGD Wet Stack- Shell Profile and Details of Main Reinforcement	FGD	-	A
22	011-109(4)-PVC-B-106	-	FGD Wet Stack- Details of Platform	FGD	-	A
23	011-109(4)-PVC-B-115	-	FGD Wet Stack- Details of Sampling Ports in Flue Liner	FGD	-	I
24	011-109(4)-PVC-B-122	-	CRUSHER HOUSE : STRUCTURAL ELEVATION AND CROSS SECTION	FGD	-	I
25	011-109(4)-PVC-B-125	-	STRUCTURAL GA OF TRANSFER POINT (FLOORS, SECTIONS)	FGD	-	I
26	011-109(4)-PVC-B-128	-	GA OF STANDARD GALLERY ALONG WITH DESIGN CALCULATION FOR Limestone and Gypsum CONVEYORS	FGD	-	A
27	011-109(4)-PVC-B-129	-	Structural GA OF GALLERY & TRESTLES FOR Limestone and Gypsum CONVEYORS	FGD	-	A
28	011-109(4)-PVC-B-136	-	CRUSHER HOUSE - G.A OF VIS	FGD	-	A
29	011-109(4)-PVC-B-137	-	GA & RCC Detail of Limestone Conveyor Trestle Foundation	FGD	-	I
30	011-109(4)-PVC-B-141	-	Structural GA of Gypsum storage area	FGD	-	I
31	011-109(4)-PVC-B-145	-	GA & RCC Details of Foundation of Gypsum Storage Shed	FGD	-	I

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32	011-109(4)-PVC-B-152	-	GA & RCC Detail of Crusher House Foundation and Base Plate Details	FGD	-	I
33	011-109(4)-PVC-B-156	-	GA & RCC Detail of Transfer Point Foundation and Base Plate Details	FGD	-	I
34	011-109(4)-PVC-B-161	-	Wind Tunnel Procedure	FGD	-	A
35	011-109(4)-PVC-B-162	-	General Information of Buildings and facilities	FGD	-	A
36	011-109(4)-PVC-B-172	-	Standard Notes for Concrete Works	FGD	-	I
37	011-109(4)-PVC-B-173	-	Standard Details for Concrete Works	FGD	-	I
38	011-109(4)-PVC-B-183	-	GA & RCC Detail of Foundation for Fan Handling Support	FGD	-	I
39	011-109(4)-PVC-B-185	-	GA & RCC Detail of Silo Support Foundation	FGD	-	A
40	011-109(4)-PVC-B-187	-	GA & RCC Detail of Truck Trippler Foundation	FGD	-	A
41	011-109(4)-PVC-B-188	-	GA & RCC Detail of BRU Unit Foundation	FGD	-	A
42	011-109(4)-PVC-B-200	-	Geotechnical Investigation Report	FGD	-	A
43	011-109(4)-PVC-U-102	-	FGD Wet Stack-Analysis and design of raft foundation and RCC shell	FGD	-	A
44	011-109(4)-PVC-U-104	-	FGD Wet Stack-Design of platform beams of Platform and GA OF FLUE LINER with restraint details and hanger	FGD	-	A
45	011-109(4)-PVC-U-105	-	FGD Wet Stack-DESIGN OF EXTRA REINFORCEMENT AROUND PLATFORM BEAM RECESSES AND OTHER MISCELLANEOUS OPENINGS	FGD	-	A
46	011-109(4)-PVC-U-106	-	FGD Wet Stack-DESIGN OF STAIRCASE	FGD	-	A
47	011-109(4)-PVC-W-001	-	FGD Wet Stack-Wind tunnel test report and Design Basis	FGD	-	A
48	011-109(4)-PVC-W-002	-	Design Basis-Machine Foundations	FGD	-	A
49	011-109(4)-PVC-W-003	-	Design Basis-Civil, Structural, Architectural Works	FGD	-	A
50	011-109(4)-PVE-B-002	-	GA. Datasheet, Terminal Box arrangement and Curves of Slurry Recirculation pump-Motor	FGD	-	A
51	011-109(4)-PVE-B-003	-	GA. Datasheet, Terminal Box arrangement and Curves of Oxidation Blower-Motor	FGD	-	A
52	011-109(4)-PVE-B-004	-	GA. Datasheet, Terminal Box arrangement and Curves of BALL MILL Motor	FGD	-	A
53	011-109(4)-PVE-B-005	-	GA. Datasheet, Terminal Box arrangement and Curves of Booster fan Motor	FGD	-	A
54	011-109(4)-PVE-B-009	-	Drawing for medium voltage VFD Panels for slurry recirculation pump	FGD	-	A
55	011-109(4)-PVE-B-020	-	GA & SLD FOR 11kV FGD TIE SWITCHGEAR	FGD	-	A
56	011-109(4)-PVE-B-022	-	BATTERY and BATTERY CHARGER (FLOAT CUM BOOST CHARGER)- DATA SHEET, GA AND SCHEMATICS	FGD	-	A
57	011-109(4)-PVE-B-030	-	Layout of Electrical & control Building	FGD	-	I
58	011-109(4)-PVE-B-060	-	GA & SLD FOR 3.3 kV FGD SWITCHGEAR	FGD	-	A
59	011-109(4)-PVE-B-070	-	TYPE TEST REPORT -LT SWITCHGEAR	FGD	-	A
60	011-109(4)-PVE-B-073	-	Type test procedure of DG.	FGD	-	A
61	011-109(4)-PVE-B-074	-	Type test procedure of Ball mill motor.	FGD	-	A

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
62	011-109(4)-PVE-B-075	-	Type test procedure of Booster fan motor.	FGD	-	A
63	011-109(4)-PVE-EL-U-025	-	DESIGN GUIDELINES FOR LIGHTNING PROTECTION	FGD	-	A
64	011-109(4)-PVE-L-004	-	Control Scheme for each type of LT Swgr module	FGD	-	A
65	011-109(4)-PVE-L-005	-	RELAY CONFIGURATION & SETTINGS FOR LT SWITCHGEAR	FGD	-	A
66	011-109(4)-PVE-L-010	-	Foundation & Loading gauge, Roller& GA & SCHEMATIC DIAGRAM FOR M. BOX oil filled trf-for each rating of oil filled transformer	FGD	-	A
67	011-109(4)-PVE-L-020	-	SCHEMATIC DIAGRAM 11/3.3 kV HV SWGR	FGD	-	A
68	011-109(4)-PVE-P-004	-	GA & SLD FOR 415V SWITCHGEAR	FGD	-	A
69	011-109(4)-PVE-U-011	-	Design Guildelines for Cabling including fixing arrangement of flexible cable tray support system	FGD	-	A
70	011-109(4)-PVE-W-003	-	Type test report for Booster fan motor	FGD	-	A
71	011-109(4)-PVE-W-004	-	TTR of Slurry Recirculation pump-Motor	FGD	-	A
72	011-109(4)-PVE-W-005	-	Type test report of Oxidation Blower-Motor	FGD	-	A
73	011-109(4)-PVE-W-006	-	Type test report of BALL MILL Motor	FGD	-	A
74	011-109(4)-PVE-W-010	-	TYPE TEST REPORTS-- oil filled trf-for each rating of oil filled transformer	FGD	-	A
75	011-109(4)-PVE-W-027	-	BATTERY and BATTERY CHARGER (FLOAT CUM BOOST CHARGER) - TYPE TEST REPORTS	FGD	-	A
76	011-109(4)-PVE-W-030	-	TYPE TEST REPORT FOR 11/3.3 KV SWITCHGEAR INCLUDING NUMERICAL RELAYS	FGD	-	A
77	011-109(4)-PVE-W-037	-	Type Test Report for power cable (HT)	FGD	-	A
78	011-109(4)-PVE-W-301	-	HT POWER CABLE SIZING CALCULATION	FGD	-	A
79	011-109(4)-PVE-W-302	-	Key Single line diagram	FGD	-	A
80	011-109(4)-PVE-W-303	-	Transformer sizing calculation	FGD	-	A
81	011-109(4)-PVE-W-304	-	Emergency DG sizing calculation	FGD	-	A
82	011-109(4)-PVE-W-305	-	Design Guidelines for Lighting System	FGD	-	A
83	011-109(4)-PVE-W-306	-	Battery sizing calculation	FGD	-	A
84	011-109(4)-PVE-W-307	-	Design Guidelines for Earthing system	FGD	-	A
85	011-109(4)-PVE-W-308	-	Type test report for VFD for slurry recirculation pump motor	FGD	-	A
86	011-109(4)-PVE-Y-002	-	DATA SHEETS FOR LT SWITCHGEAR AND BUS DUCT (NSPB)	FGD	-	A
87	011-109(4)-PVE-Y-010	-	TECHNICAL DATA REQUIREMENT SHEET- oil filled trf-for each rating of oil filled transformer	FGD	-	A
88	011-109(4)-PVE-Y-015	-	Datasheet and Cross Section Drawings for Power Cables (HT)	FGD	-	A
89	011-109(4)-PVE-Y-016	-	DATA SHEETS FOR DG SET COMPLETE WITH ALL ACCESSORIES	FGD	-	A
90	011-109(4)-PVE-Y-020	-	RELAY CONFIGURATION & SETTINGS FOR HT SWITCHGEAR	FGD	-	A
91	011-109(4)-PVE-Y-030	-	DATASHEET FOR 11/3.3 KV SWITCHGEAR INCLUDING NUMERICAL RELAYS	FGD	-	A
92	011-109(4)-PVI-B-006	-	Drawing & datasheet of Radar type Level Transmitter (for Silo)	FGD	-	A
93	011-109(4)-PVI-F-003	-	DATASHEET FOR FIELD BUS COMPONENTS/DEVICES/ FIELDBUS JBS	FGD	-	A

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
94	011-109(4)-PVI-G-002	-	I/O and Drive List	FGD	-	A
95	011-109(4)-PVI-L-002	-	TYPICAL GA/IA with AC/ DC POWER DISTRIBUTION FOR DDCMIS AND GROUNDING SCHEME	FGD	-	A
96	011-109(4)-PVI-P-002	-	CONTROL SYSTEM FDS INCLUDING FIELDBUS(HARDWARE FEATURES, OLCS/CLCS IMPLEMENTATION, DRIVE MACROS ALONG WITH POP-UPS)	FGD	-	A
97	011-109(4)-PVI-P-009	-	CONTROL SYSTEM CONFIGURATION DIAGRAM of FGD System	FGD	-	A
98	011-109(4)-PVI-T-001	-	Complete Logic diagrams of FGD system with Sequence, protection and interlock schemes.	FGD	-	A
99	011-109(4)-PVI-T-002	-	BOM & datasheet of HMI Items(Servers, O, Switches, Mini UPS)	FGD	-	A
100	011-109(4)-PVI-V-002	-	Datasheet of Non-Intrusive Motorised Actuators	FGD	-	A
101	011-109(4)-PVI-V-003	-	FDS of HMI	FGD	-	A
102	011-109(4)-PVI-W-001	-	ATST Procedure - FGD System	FGD	-	A
103	011-109(4)-PVI-W-023	-	Pre-ATST report-FGD Control system	FGD	-	A
104	011-109(4)-PVI-Y-009	-	Data Sheet/Drawing for SO2 Analyser	FGD	-	A
105	011-109(4)-PVI-Y-010	-	Data Sheet/Drawing for pH Analyser	FGD	-	A
106	011-109(4)-PVI-Y-021	-	Datasheet & GA Drawing of Pressure Transmitter	FGD	-	A
107	011-109(4)-PVI-Y-022	-	Datasheet & GA Drawing of Temperature Transmitter	FGD	-	A
108	011-109(4)-PVI-Y-024	-	Datasheet & GA Drawing of DP type Transmitter	FGD	-	A
109	011-109(4)-PVI-Y-026	-	Datasheet & GA Drawing of Coriolis Density Meter	FGD	-	A
110	011-109(4)-PVI-Y-032	-	DATA SHEET / BOM / GA / SCHEMATIC / SAMPLING DRG FOR SOX/NOX/CO2/CO ANALYZERS, DUST DENSITY/SPM ANALYSER, MERCURY ANALYSER, FLUE GAS FLOWMETER AND ASSOCIATED SYSTEM OF CEMS	FGD	-	A
111	011-109(4)-PVI-Y-036	-	SCHEMATIC DRAWING SHOWING INTERFACING OF CEMS ANALYSERS WITH DDCMIS AND CLOUD SERVER	FGD	-	A
112	011-109(4)-PVM-B-001	-	General Arrangement & Data sheet of Elevator	FGD	-	I
113	011-109(4)-PVM-B-004	-	Data sheet & General Arrangement of Limestone Pulverizer(Wet ball Mill)	FGD	-	A
114	011-109(4)-PVM-B-006	-	Data sheet & General Arrangement of All water pumps	FGD	-	I
115	011-109(4)-PVM-B-010	-	Data sheet & General Arrangement and Foundation load data for Absorber along with staircase and platform	FGD	-	A
116	011-109(4)-PVM-B-011	-	Data sheet & General Arrangement for Slurry Recirculation Pumps	FGD	-	A
117	011-109(4)-PVM-B-012	-	Data sheet & General Arrangement for Oxidation Air Blower	FGD	-	A
118	011-109(4)-PVM-B-014	-	Data sheet & General Arrangement for all slurry pumps	FGD	-	I
119	011-109(4)-PVM-B-022	-	Data sheet & General Arrangement of Vacuum Belt filters	FGD	-	A
120	011-109(4)-PVM-B-028	-	Data Sheet & GA for Sump Pumps for FGD ,Milling and Dewatering Area	FGD	-	A
121	011-109(4)-PVM-B-033	-	General Arrangement & Schedule of expansion joint	FGD	-	I

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
122	011-109(4)-PVM-B-037	-	General Arrangement & Data sheet for Booster fan	FGD	-	A
123	011-109(4)-PVM-B-045	-	General arrangement of Recycle Pump & Oxidation Blower Building	FGD	-	A
124	011-109(4)-PVM-B-047	-	General arrangement of Ball Mill Building & gypsum De-water Building	FGD	-	A
125	011-109(4)-PVM-B-049	-	General Layout of FGD Ducting	FGD	-	A
126	011-109(4)-PVM-B-050	-	General Layout of Pipe rack/trestle & Cable ways	FGD	-	A
127	011-109(4)-PVM-B-073	-	PLOT PLAN OF LIME STONE & GYPSUM HANDLING PLANT	FGD	-	A
128	011-109(4)-PVM-B-074	-	FLOW DIAGRAM OF limestone AND GYPSUM HANDLING PLANT	FGD	-	A
129	011-109(4)-PVM-B-076	-	TYP MECHANICAL CROSS SECTION OF CONV	FGD	-	A
130	011-109(4)-PVM-B-077	-	GA OF BRU/ Surface feeder	FGD	-	A
131	011-109(4)-PVM-B-078	-	GA OF LIME STONE TP-1	FGD	-	A
132	011-109(4)-PVM-B-084	-	DESIGN CALCULATION FOR CONVEYOR INCLUDING POWER, TENSION AND BELT RATING	FGD	-	A
133	011-109(4)-PVM-B-088	-	G.A. OF CRUSHED LIMESTONE STORAGE SILO	FGD	-	A
134	011-109(4)-PVM-B-089	-	GA of Gypsum Storage Shed	FGD	-	A
135	011-109(4)-PVM-B-090	-	Design Basis and P&ID for De-Dusting System for limestone handling system and gypsum storage area	FGD	-	I
136	011-109(4)-PVM-B-091	-	GA OF LIME STONE CRUSHER HOUSE	FGD	-	A
137	011-109(4)-PVM-B-099	-	GA OF Truck Tippler	FGD	-	A
138	011-109(4)-PVM-B-101	-	GA OF FLAP GATE ALONG WITH THRUST AND ACTUATOR SELECTION	FGD	-	A
139	011-109(4)-PVM-B-102	-	GA OF LIMSTONE BUCKET ELEVATOR- BE 1 A/B	FGD	-	A
140	011-109(4)-PVM-B-104	-	GA OF TRAVELLING TRIPPER & BUNKER SEALING ARRANGMENT	FGD	-	A
141	011-109(4)-PVM-B-107	-	GA, OF ILMS ALONG WITH CONTROL PANEL	FGD	-	A
142	011-109(4)-PVM-B-109	-	GA DRG. OF METAL DETECTOR ALONG WITH CONTROL PANEL	FGD	-	A
143	011-109(4)-PVM-B-110	-	GA AND DATA SHEET OF BELT WEIGHER ALONG WITH CONTROL PANEL	FGD	-	A
144	011-109(4)-PVM-B-112	-	G.A OF SAMPLING SYSTEM EQPT INSIDE LIMESTONE CRUSHER HOUSE	FGD	-	I
145	011-109(4)-PVM-B-114	-	LIME STONE AND GYPUSM CONVEYOR IDLER SCHEDULE	FGD	-	I
146	011-109(4)-PVM-B-118	-	BELT DATA SHEET WITH SCHEDULE	FGD	-	I
147	011-109(4)-PVM-B-119	-	PULLEY SCHEDULE AND GA	FGD	-	I
148	011-109(4)-PVM-B-121	-	General Arrangement Bag Filter for Limestone Day Silos	FGD	-	A
149	011-109(4)-PVM-B-123	-	CONTROL WRITE UP / FUNCTIONAL PHILOSOPHY OF LIME HANDLING PLANT & GYPSUM HANDLING	FGD	-	I
150	011-109(4)-PVM-B-136	-	G.A. OF LIME STONE CRUSHER	FGD	-	A
151	011-109(4)-PVM-B-137	-	Sizing of Equipment Closed Water Cooling System	FGD	-	I
152	011-109(4)-PVM-B-143	-	GA and load data of all tanks (Slurry tank, Filtrate tank & Water tank)	FGD	-	I
153	011-109(4)-PVM-B-167	-	G.A. & Load Data of Vibrating Feeder	FGD	-	I

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
154	011-109(4)-PVM-B-170	-	GA OF CONVEYOR- LC 1A/B, 2A/2B, 3A/3B,4A/4B,5A/5B	FGD	-	A
155	011-109(4)-PVM-B-175	-	GA OF CONVEYOR- GC 1A/1B	FGD	-	A
156	011-109(4)-PVM-B-176	-	Sizing calculation of Limestone storage silos	FGD	-	A
157	011-109(4)-PVM-B-177	-	Sizing calculation of Gypsum storage shed.	FGD	-	A
158	011-109(4)-PVM-B-201	-	P&ID along with process description - All sump & pump	FGD	-	A
159	011-109(4)-PVM-B-202	-	Predicted Performance of FGD System at 50%.60%. 80% and 100% for a) Design coal , b) worst coal & C) best coal	FGD	-	I
160	011-109(4)-PVM-B-203	-	Sizing Calculation for Gypsum Dewatering System	FGD	-	A
161	011-109(4)-PVM-B-204	-	Sizing & General Arrangement of Mill circuit Tank	FGD	-	A
162	011-109(4)-PVM-B-208	-	Tippling Arrangement for Truck tippler	FGD	-	A
163	011-109(4)-PVM-B-229	-	Structural GA of Lime stone Silo	FGD	-	I
164	011-109(4)-PVM-B-230	-	DESIGN PHILOSOPHY OF COMPRESSED AIR SYSTEM INCLUDING SIZING CALCULATIONS OF COMPRESSOR and P&ID	FGD	-	A
165	011-109(4)-PVM-B-231	-	Design Philosophy for Hydrant & Spray System and Write-up for Fire Detection & Alarm System.	FGD	-	A
166	011-109(4)-PVM-B-232	-	Layout of Hydrant and Spray System for FGD Area including layout of internal hydrant system of various buildings	FGD	-	A
167	011-109(4)-PVM-B-233	-	Layout of Fire Detection & Alarm System for FGD CONTROL BUILDING, Cable Galleries, MCC/Switchgear and LHS Cable for Cable Galleries	FGD	-	A
168	011-109(4)-PVM-B-235	-	DESIGN PHILOSOPHY of A/C & VENTILATION SYSTEM INCLUDING HEAT LOAD CALCULATION OF FGD CONTROL BUILDING & SCHEDULE OF SPLIT AIR CONDITIONERS	FGD	-	A
169	011-109(4)-PVM-B-238	-	TDS and GA OF AIR COMPRESSOR, Air Dryer and Air Receivers	FGD	-	A
170	011-109(4)-PVM-B-239	-	Layout of HVW Spray System alongwith Pressure Drop Calculation for Transformers	FGD	-	A
171	011-109(4)-PVM-B-241	-	Compressor House layout incl. civil foundation details of various equipments	FGD	-	A
172	011-109(4)-PVM-B-254	-	Layout of MVW Spray System alongwith Pressure Drop Calculation for Cable Galleries	FGD	-	A
173	011-109(4)-PVM-B-255	-	Layout of LHS Detection System for Lime Stone & Gypsum Conveyors	FGD	-	A
174	011-109(4)-PVM-B-256	-	TECHNICAL DATA SHEET & GA OF AIR HANDLING UNITS INCLUDING FAN, FILTERS, COOLING COIL, ETC.	FGD	-	A
175	011-109(4)-PVM-B-257	-	EQUIPMENT LAYOUT OF UAF UNIT ALONGWITH FOUNDATION DETAIL AND VENTILATION DUCT LAYOUT FOR FGD BUILDING.	FGD	-	A

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
176	011-109(4)-PVM-B-258	-	TECHNICAL DATA SHEET & G.A. DRAWING OF FIRE DAMPER WITH ACTUATOR, HEATER & PAN HUMIDIFIER FOR A/C & VENTILATION SYSTEM	FGD	-	A
177	011-109(4)-PVM-B-259	-	TECHNICAL DATA SHEET & G.A DRAWING OF AIR-COOLED CONDENSING UNIT FOR FGD CONTROL BUILDING INCLUDING P&ID	FGD	-	A
178	011-109(4)-PVM-B-264	-	A/C EQUIPMENT LAYOUT (AHU & OUTDOOR UNITS) WITH COMPLETE FOUNDATION DETAIL AND A/C DUCT LAYOUT FOR FGD CONTROL BUILDING	FGD	-	A
179	011-109(4)-PVM-B-266	-	EQUIPMENT LAYOUT OF UAF UNIT ALONGWITH FOUNDATION DETAIL AND VENTILATION DUCT LAYOUT FOR FGD BUILDING.	FGD	-	A
180	011-109(4)-PVM-F-001	-	P&ID along with process description - Absorber ,Oxidation Blower,Gypsum Bleed Pump & Filtrate Water System ,Mist Eliminator	FGD	-	A
181	011-109(4)-PVM-F-017	-	P&ID along with process description - Limestone Pulverizer-Wet Ball Mill & ,Reagent Preparation System, Feed tank& Pump	FGD	-	A
182	011-109(4)-PVM-F-020	-	P&ID - Primary & secondary Dewatering,Waste Water Discharge System	FGD	-	A
183	011-109(4)-PVM-F-044	-	Plant Layout of FGD System	FGD	-	A
184	011-109(4)-PVM-F-045	-	GA of Gates and dampers	FGD	-	A
185	011-109(4)-PVM-F-046	-	P&ID along with process description ,Sizing Calculation and selection Criteria of waste	FGD	-	A
186	011-109(4)-PVM-F-047	-	Process Flow Diagram of FGD System	FGD	-	A
187	011-109(4)-PVM-F-079	-	P&ID along with process description- Flue Gas Ducting and Dampers System	FGD	-	A
188	011-109(4)-PVM-H-001	-	Painting schedule of FGD System	FGD	-	A
189	011-109(4)-PVM-H-004	-	Insulation Schedule	FGD	-	I
190	011-109(4)-PVM-H-006	-	Schedule of Hoists	FGD	-	A
191	011-109(4)-PVM-U-002	-	Flue gas system design, Chimney and Duct Sizing Calculation	FGD	-	A
192	011-109(4)-PVM-U-003	-	ABSORBER DESIGN BASIS/CRITERIA	FGD	-	A
193	011-109(4)-PVM-U-005	-	Sizing Calculation & Selection parameter for Slurry Recirculation Pumps	FGD	-	A
194	011-109(4)-PVM-U-006	-	Sizing Calculation & Selection parameter for Oxidation Air Blower	FGD	-	A
195	011-109(4)-PVM-U-007	-	Sizing Calculation& Selection parameter for Emergency Quench Water System	FGD	-	A
196	011-109(4)-PVM-U-008	-	Sizing Calculation & Selection parameter for all slurry pumps	FGD	-	A
197	011-109(4)-PVM-U-009	-	Sizing Calculation ,Selection parameter for all tanks (Slurry & Water)	FGD	-	A
198	011-109(4)-PVM-U-011	-	Sizing Calculation& Selection parameter for Wet ball Mill	FGD	-	A
199	011-109(4)-PVM-U-012	-	Sizing Calculation & Selection parameter for Vacuum Belt filters	FGD	-	A
200	011-109(4)-PVM-U-014	-	Sizing Calculation & Selection parameter for all Water Pumps	FGD	-	A
201	011-109(4)-PVM-U-016	-	Sizing Calculation & Selection parameter for BOOSTER FANS	FGD	-	A
202	011-109(4)-PVM-U-017	-	Sizing Calculation & Selection parameter for Sump pumps	FGD	-	A
203	011-109(4)-PVM-U-030	-	Condensate Study for Low Height Chimney	FGD	-	A

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
204	011-109(4)-PVM-W-002	-	Mass Flow Balance (Design Point & Guarantee point) data and FGD System Design Basis - PROCESS	FGD	-	A
205	011-109(4)-PVM-W-011	-	Type test procedure for Gates & Dampers	FGD	-	A
206	011-109(4)-PVM-W-012	-	Type Test Performance Procedure for BOOSTER FANS	FGD	-	A
207	011-109(4)-PVM-W-013	-	Type Test Performance Report for BOOSTER FANS	FGD	-	A
208	011-109(4)-PVM-W-016	-	Leak tightness performance test Report of damper/gates	FGD	-	A
209	011-109(4)-PVM-X-001	-	O & M MANUAL FGD SYSTEM	FGD	-	I
210	011-109(4)-PVM-Y-008	-	GA & Data sheet of Mist Eliminator	FGD	-	A
211	011-109(4)-QVC-G-001	-	FQP for FGD (including Receipt & Storage)	FGD	-	A
212	011-109(4)-QVE-Q-001	-	MQP for HT Cable	FGD	-	A
213	011-109(4)-QVE-Q-002	-	MQP for Oil Filled Aux. Transformer	FGD	-	A
214	011-109(4)-QVE-Q-003	-	MQP for HT Motor	FGD	-	A
215	011-109(4)-QVE-Q-004	-	MQP for HT Switch gear	FGD	-	A
216	011-109(4)-QVE-Q-005	-	MQP for LT MCC/ACP/PMCC	FGD	-	A
217	011-109(4)-QVE-Q-006	-	MQP for LT/HT Bus duct	FGD	-	A
218	011-109(4)-QVE-Q-007	-	MQP for Battery & Battery Charger	FGD	-	A
219	011-109(4)-QVE-Q-008	-	MQP for DG Set	FGD	-	A
220	011-109(4)-QVE-Q-009	-	MQP for VFD Control Panel	FGD	-	A
221	011-109(4)-QVE-Q-010	-	MQP FOR BATTERIES FOR UPS	FGD	-	A
222	011-109(4)-QVI-Q-001	-	MQP FOR DDCMIS	FGD	-	A
223	011-109(4)-QVI-Q-002	-	MQP FOR FLUE GAS ANALYSER	FGD	-	A
224	011-109(4)-QVI-Q-003	-	MQP for Pneumatic Control Valves	FGD	-	A
225	011-109(4)-QVM-Q-001	-	MQP for Oxidation Blower	FGD	-	A
226	011-109(4)-QVM-Q-002	-	MQP for Booster Fan	FGD	-	A
227	011-109(4)-QVM-Q-003	-	MQP for Agitator	FGD	-	A
228	011-109(4)-QVM-Q-004	-	MQP for slurry pump	FGD	-	A
229	011-109(4)-QVM-Q-005	-	MQP for Vacuum Belt Filter	FGD	-	A
230	011-109(4)-QVM-Q-006	-	MQP of Wet lime stone Grinding Mill	FGD	-	A
231	011-109(4)-QVM-Q-007	-	MQP for Gate /Damper	FGD	-	A
232	011-109(4)-QVM-Q-008	-	MQP for Instrument Air Compressor	FGD	-	A
233	011-109(4)-QVM-Q-009	-	MQP for Passenger Elevator	FGD	-	A
234	011-109(4)-QVM-Q-010	-	MQP FOR Crusher	FGD	-	A
235	011-109(4)-QVM-Q-011	-	MQP FOR Vibrating Screen feeder	FGD	-	A
236	011-109(4)-QVM-Q-012	-	MQP FOR Limestone Sampling System	FGD	-	A
237	011-109(4)-QVM-Q-013	-	MQP FOR Belt	FGD	-	A

S.NO.	NTPC_DRG_NO	VENDOR_ DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT
238	011-109(4)-QVM-Q-014	-	MQP FOR Gearbox	FGD	-	A
239	011-109(4)-QVM-Q-015	-	MQP FOR Fluid Coupling	FGD	-	A
240	011-109(4)-QVM-Q-016	-	MQP for Absorber	FGD	-	A
241	011-109(4)-QVM-Q-017	-	MQP for Re-circulation Slurry Pump	FGD	-	A

Annexure-A2- Auto Archive Category

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
1	011-109(4)-PVC-B-002	-	GA & RCC Detail of Foundation of Primary & Secondary HC Feed Tank	FGD	-	I	Auto Archive
2	011-109(4)-PVC-B-004	-	GA & RCC Detail of Foundation of Waste water Tank	FGD	-	I	Auto Archive
3	011-109(4)-PVC-B-016	-	GA & RCC Details of Foundation of Electrical equipment & control Building-I	FGD	-	I	Auto Archive
4	011-109(4)-PVC-B-017	-	GA & RCC Details of Foundation of Electrical equipment & control Building-II	FGD	-	I	Auto Archive
5	011-109(4)-PVC-B-021	-	Gypsum Dewatering Building : GA & RC Details of Foundation	FGD	-	I	Auto Archive
6	011-109(4)-PVC-B-024	-	GA & RCC Details of Foundation of Recycle Pump & Oxidation Blower Building	FGD	-	I	Auto Archive
7	011-109(4)-PVC-B-033	-	GA & RCC Detail of Foundation of Oxidation blower	FGD	-	I	Auto Archive
8	011-109(4)-PVC-B-041	-	GA & RCC detail of Foundation of Transformer	FGD	-	I	Auto Archive
9	011-109(4)-PVC-B-044	-	GA & RCC detail of miscellaneous pump-I(Belt Filter Wash, Aux. Storage, Mist Eleminator,Process water)	FGD	-	I	Auto Archive
10	011-109(4)-PVC-B-045	-	GA & RCC detail of miscellaneous pump-II(Cooling water, Gypsum Bleed, Reagent Feed)	FGD	-	I	Auto Archive
11	011-109(4)-PVC-B-046	-	GA & RCC Detail of Foundation of Recycle Pump	FGD	-	I	Auto Archive
12	011-109(4)-PVC-B-072	-	GA & RCC Detail of Foundation for Absorber Inlet Duct Support	FGD	-	I	Auto Archive
13	011-109(4)-PVC-B-110	-	FGD Wet Stack- Layout & Details of Staircase	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
14	011-109(4)-PVC-B-111	-	FGD Wet Stack- Details of Ladders, Hatches and other Miscellaneous Items	FGD	-	I	Auto Archive
15	011-109(4)-PVC-B-112	-	FGD Wet Stack- Details of Roof Slab	FGD	-	I	Auto Archive
16	011-109(4)-PVC-B-113	-	FGD Wet Stack- Details of Grade Level Slab	FGD	-	I	Auto Archive
17	011-109(4)-PVC-B-114	-	FGD Wet Stack- Scheme for Aviation Obstruction Markings	FGD	-	I	Auto Archive
18	011-109(4)-PVC-B-116	-	FGD Wet Stack-Details of Rain Water Downtake pipe	FGD	-	I	Auto Archive
19	011-109(4)-PVC-B-117	-	FGD Wet Stack-Details of Louvers For Air inlet opening	FGD	-	I	Auto Archive
20	011-109(4)-PVC-B-118	-	FGD Wet Stack-Details of Door For Aviation warning lights & Relief opening	FGD	-	I	Auto Archive
21	011-109(4)-PVC-B-119	-	FGD Wet Stack-Details of Access Door	FGD	-	I	Auto Archive
22	011-109(4)-PVC-B-120	-	FGD Wet Stack-Details of Rolling Shutter	FGD	-	I	Auto Archive
23	011-109(4)-PVC-B-142	-	DETAILS OF FLUE LINER WITH MANHOLES- All CANS	FGD	-	I	Auto Archive
24	011-109(4)-PVC-B-155	-	CRUSHER HOUSE-GA & RCC DETAIL OF GRADE SLAB	FGD	-	I	Auto Archive
25	011-109(4)-PVC-B-157	-	TRANSFER POINT- GA & RCC DET OF GRADE SLAB	FGD	-	I	Auto Archive
26	011-109(4)-PVC-B-160	-	GA & RCC Detail of Bucket Elevator Support Foundation	FGD	-	I	Auto Archive
27	011-109(4)-PVC-B-186	-	GA & RCC Detail of Weigh Bridge Foundation	FGD	-	I	Auto Archive
28	011-109(4)-PVC-B-189	-	GA & RCC Detail of Ramp	FGD	-	I	Auto Archive
29	011-109(4)-PVC-B-201	-	GA & RCC Detail of Foundation of Filtrate Water Tank	FGD	-	I	Auto Archive
30	011-109(4)-PVC-B-216	-	GA & RCC Detail of Foundation of Process Water Tank	FGD	-	I	Auto Archive
31	011-109(4)-PVC-B-233	-	Architectural dwg of Electrical equipment & control Building-II	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
32	011-109(4)-PVC-B-235	-	Architectural dwg of Gypsum Storage Shed	FGD	-	I	Auto Archive
33	011-109(4)-PVC-B-237	-	GA & RCC detail of trench and sump	FGD	-	I	Auto Archive
34	011-109(4)-PVC-B-238	-	GA & RCC Detail of equipment closed water cooling system	FGD	-	I	Auto Archive
35	011-109(4)-PVC-B-239	-	GA & RCC Detail of Gypsum Conveyor Trestle Foundation	FGD	-	I	Auto Archive
36	011-109(4)-PVC-B-240	-	GA AND RCC DETAIL OF OXY BLOWER SHED FOUNDATION	FGD	-	I	Auto Archive
37	011-109(4)-PVC-B-241	-	Gypsum Dewatering Building : GA & RC Details of Grade Beam	FGD	-	I	Auto Archive
38	011-109(4)-PVC-B-242	-	Gypsum Dewatering Building : GA & RC Details of Lintel Beam	FGD	-	I	Auto Archive
39	011-109(4)-PVC-B-243	-	Gypsum Dewatering Building : GA & RC Details of Floor Beam & Slab	FGD	-	I	Auto Archive
40	011-109(4)-PVC-B-244	-	Gypsum Dewatering Building : GA & RC Detail of Roof Beam & Slab	FGD	-	I	Auto Archive
41	011-109(4)-PVC-B-245	-	Gypsum Dewatering Building : GA & RC Detail of Stairs	FGD	-	I	Auto Archive
42	011-109(4)-PVC-B-246	-	Gypsum Dewatering Building : GA & RC Details of Grade Slab	FGD	-	I	Auto Archive
43	011-109(4)-PVC-B-247	-	Ball Mill Building : GA & RC Detail of Grade Beam	FGD	-	I	Auto Archive
44	011-109(4)-PVC-B-248	-	Ball Mill Building : GA & RC Detail of Lintel Beam	FGD	-	I	Auto Archive
45	011-109(4)-PVC-B-249	-	Ball Mill Building : GA & RC Detail of Floor Beam & Slab	FGD	-	I	Auto Archive
46	011-109(4)-PVC-B-250	-	Ball Mill Building : GA & RC Detail of Roof Beam & Slab	FGD	-	I	Auto Archive
47	011-109(4)-PVC-B-251	-	Ball Mill Building : GA & RC Details of Grade Slab	FGD	-	I	Auto Archive
48	011-109(4)-PVC-B-252	-	Electrical equipment & control Building-I: RC detail of column	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
49	011-109(4)-PVC-B-253	-	Electrical equipment & control Building-I: GA & RC detail of grade beam	FGD	-	I	Auto Archive
50	011-109(4)-PVC-B-254	-	Electrical equipment & control Building-I: GA & RC detail of lintel beam	FGD	-	I	Auto Archive
51	011-109(4)-PVC-B-255	-	Electrical equipment & control Building-I: GA & RC detail of floor beam & slab	FGD	-	I	Auto Archive
52	011-109(4)-PVC-B-256	-	Electrical equipment & control Building-I: GA & RC detail of roof beam & slab	FGD	-	I	Auto Archive
53	011-109(4)-PVC-B-257	-	Electrical equipment & control Building-I: GA & RC detail of staircases	FGD	-	I	Auto Archive
54	011-109(4)-PVC-B-258	-	Electrical equipment & control Building-I: GA & RC detail of grade slab	FGD	-	I	Auto Archive
55	011-109(4)-PVC-B-259	-	Electrical equipment & control Building-II: RC detail of column	FGD	-	I	Auto Archive
56	011-109(4)-PVC-B-260	-	Electrical equipment & control Building-II: GA & RC detail of grade beam	FGD	-	I	Auto Archive
57	011-109(4)-PVC-B-261	-	Electrical equipment & control Building-II: GA & RC detail of lintel beam	FGD	-	I	Auto Archive
58	011-109(4)-PVC-B-262	-	Electrical equipment & control Building-II: GA & RC detail of floor beam & slab	FGD	-	I	Auto Archive
59	011-109(4)-PVC-B-263	-	Electrical equipment & control Building-II: GA & RC detail of roof beam & slab	FGD	-	I	Auto Archive
60	011-109(4)-PVC-B-264	-	Electrical equipment & control Building-II: GA & RC detail of staircases	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
61	011-109(4)-PVC-B-265	-	Electrical equipment & control Building-II: GA & RC detail of grade slab	FGD	-	I	Auto Archive
62	011-109(4)-PVC-B-273	-	Gypsum Storage Shed : RC Detail of Column	FGD	-	I	Auto Archive
63	011-109(4)-PVC-B-274	-	Gypsum Storage Shed : GA & RC Detail of Grade Beam	FGD	-	I	Auto Archive
64	011-109(4)-PVC-B-275	-	Gypsum Storage Shed : GA & RC Detail of Lintel Beam	FGD	-	I	Auto Archive
65	011-109(4)-PVC-B-276	-	Gypsum Storage Shed : GA & RC Detail of Roof Beam & Slab	FGD	-	I	Auto Archive
66	011-109(4)-PVE-B-006	-	GA DRG FOR LOCAL PUSH BUTTON STATION	FGD	-	I	Auto Archive
67	011-109(4)-PVE-B-008	-	Technical Data sheet for Segregated Phase Busduct and accessories	FGD	-	I	Auto Archive
68	011-109(4)-PVE-B-010	-	POWER DISTRIBUTION SCHEME FOR Wet Stack	FGD	-	I	Auto Archive
69	011-109(4)-PVE-B-011	-	DETAILS OF LIGHTNING PROTECTION & EARTHING	FGD	-	I	Auto Archive
70	011-109(4)-PVE-B-014	-	LIGHTING PANEL, POWER PANEL , AVAIATION LIGHTING PANEL , EMERGENCY LIGHTING PANEL & MLDB - GL, SLD & SCHEMATICS FOR Wet Stack	FGD	-	I	Auto Archive
71	011-109(4)-PVE-B-015	-	DATA SHEET FOR FIXED POWER AND CONTROL CABLES	FGD	-	I	Auto Archive
72	011-109(4)-PVE-B-016	-	DATA SHEET FOR TRAILING POWER CABLE	FGD	-	I	Auto Archive
73	011-109(4)-PVE-B-017	-	LAYOUT FOR AVIATION LIGHTING SYSTEM	FGD	-	I	Auto Archive
74	011-109(4)-PVE-B-021	-	Datasheet and Cross Section Drawings for LT Power Cables	FGD	-	I	Auto Archive
75	011-109(4)-PVE-B-026	-	HT CABLE JOINTING & TERMINATIONS KIT- DATA SHEET, DETAILS & DRAWINGS.	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
76	011-109(4)-PVE-B-062	-	GA DRAWINGS & DETAILS OF CABLE TRAY & ACCESSORIES	FGD	-	I	Auto Archive
77	011-109(4)-PVE-B-063	-	SCHEME DIAGRAM, TERMINAL DETAILS, GA, BOM AND CONTROL CIRCUIT FOR CAGE & BASE ELEVATOR PANEL FOR Wet Stack	FGD	-	I	Auto Archive
78	011-109(4)-PVE-B-066	-	Type Test Report for LT Power cable	FGD	-	I	Auto Archive
79	011-109(4)-PVE-B-069	-	DG SETS LAYOUT DRAWINGS AND SECTIONAL DETAILS INCLUDING FOUNDATION DRAWING & DETAILS FOR ACOUSTIC ENCLOSURE	FGD	-	I	Auto Archive
80	011-109(4)-PVE-B-071	-	TTR for UPS and battery-230VAC	FGD	-	I	Auto Archive
81	011-109(4)-PVE-B-072	-	GA, Datasheet and Wiring Diagram for VMS	FGD	-	I	Auto Archive
82	011-109(4)-PVE-B-076	-	TEMPORARY EARTHING & LIGHTNING DETAILS OF CHIMNEY	FGD	-	I	Auto Archive
83	011-109(4)-PVE-B-077	-	DETAILS OF INTERNAL LIGHTING	FGD	-	I	Auto Archive
84	011-109(4)-PVE-B-078	-	RECEPTACLES-BOXES (RB TYPE)- OUTLINE DIMENSION DRAWING/GA DRAWINGS & DATA SHEET	FGD	-	I	Auto Archive
85	011-109(4)-PVE-B-079	-	LIGHTING FIXTURES & ACCESSORIES - DATA SHEET & GA DRAWINGS .	FGD	-	I	Auto Archive
86	011-109(4)-PVE-B-080	-	GA & SLD FOR AC AND DC FUSE BOARD	FGD	-	I	Auto Archive
87	011-109(4)-PVE-B-081	-	CABLE GLANDS Catalogue	FGD	-	I	Auto Archive
88	011-109(4)-PVE-B-082	-	CABLE TREFOIL CLAMPS - DETAILS, DRAWINGS & MANUFACTURER CATALOGUE FOR HT POWER CABLES & LT POWER CABLES.	FGD	-	I	Auto Archive
89	011-109(4)-PVE-B-083	-	LIGHTING MASTS - OUTLINE DIMENSIONS DRAWING/GA DRAWINGS & DATASHEET	FGD	-	I	Auto Archive
90	011-109(4)-PVE-B-084	-	CABLE LUGS/FERRULES MANUFACTURER'S CATALOGUES.	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
91	011-109(4)-PVE-B-085	-	LIGHTING POLES - OUTLINE DIMENSIONS DRAWING/GA DRAWINGS & DATASHEET	FGD	-	I	Auto Archive
92	011-109(4)-PVE-B-086	-	DATA SHEET & GA DRG FOR POWER RECEPTACLES	FGD	-	I	Auto Archive
93	011-109(4)-PVE-B-087	-	INSTRUCTION AND O&M MANUAL--Oil filler trf.-for each rating of oil filled transformer	FGD	-	I	Auto Archive
94	011-109(4)-PVE-B-088	-	BATTERY CHARGER - O&M AND COMMISSIONING MANUAL	FGD	-	I	Auto Archive
95	011-109(4)-PVE-B-089	-	BATTERY - O&M AND COMMISSIONING MANUAL	FGD	-	I	Auto Archive
96	011-109(4)-PVE-B-090	-	O&M manual for HT Motors	FGD	-	I	Auto Archive
97	011-109(4)-PVE-B-091	-	DG SETS - O&M AND COMMISSIONING MANUAL	FGD	-	I	Auto Archive
98	011-109(4)-PVE-B-092	-	Data sheets, sizing calculation and type test for UPS and Battery	FGD	-	I	Auto Archive
99	011-109(4)-PVE-B-093	-	Data sheets, sizing calculation and type test for Battery Charger and Battery	FGD	-	I	Auto Archive
100	011-109(4)-PVE-B-094	-	Datasheet & GA Drawing of GI Conduit	FGD	-	I	Auto Archive
101	011-109(4)-PVE-BD-L-001	-	Layout, Foundation and Supporting structure & EKD of Segregated Phase Busduct	FGD	-	I	Auto Archive
102	011-109(4)-PVE-EL-B-020	-	JUNCTION BOXES (TYPE F) - OUTLINE DIMENSION DRAWING/GA DRAWINGS & DATA SHEET	FGD	-	I	Auto Archive
103	011-109(4)-PVE-EL-F-006	-	Earthing Layout for complete FGD Area & Limestone & Gypsum Handling area	FGD	-	I	Auto Archive
104	011-109(4)-PVE-EL-H-001	-	Cable schedule for power & control cables	FGD	-	I	Auto Archive
105	011-109(4)-PVE-EL-U-022	-	HT CABLE JOINTING & TERMINATIONS KIT- INSTALLATION PROCEDURE.	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
106	011-109(4)-PVE-F-004	-	Detail Cable Routing Plan for complete FGD Area & Limestone & Gypsum Handling area	FGD	-	I	Auto Archive
107	011-109(4)-PVE-F-005	-	Illumination Layout and Road / Area Lighting layout for complete FGD Area & Limestone & Gypsum Handling area	FGD	-	I	Auto Archive
108	011-109(4)-PVE-F-007	-	Lightning Protection Layout for complete FGD Area & Limestone & Gypsum Handling area	FGD	-	I	Auto Archive
109	011-109(4)-PVE-L-030	-	Lighting Layout for FGD Control Room building and Other Building	FGD	-	I	Auto Archive
110	011-109(4)-PVE-P-003	-	GA AND SLD FOR AC AND DC LIGHTING DB AND WELDING DB	FGD	-	I	Auto Archive
111	011-109(4)-PVE-W-001	-	Electrical load list for complete FGD system	FGD	-	I	Auto Archive
112	011-109(4)-PVE-W-002	-	Type test reports (above 50 KW LT motors)	FGD	-	I	Auto Archive
113	011-109(4)-PVE-W-021	-	TYPE TEST REPORTS FOR (F TYPE) JUNCTION BOX	FGD	-	I	Auto Archive
114	011-109(4)-PVE-W-022	-	LIGHT FIXTURE TYPE TEST REPORTS	FGD	-	I	Auto Archive
115	011-109(4)-PVE-W-023	-	TYPE TEST REPORTS FOR LIGHTING PANELS	FGD	-	I	Auto Archive
116	011-109(4)-PVE-W-025	-	CABLE TRAY SUPPORT SYSTEM - TYPE TEST REPORTS.	FGD	-	I	Auto Archive
117	011-109(4)-PVE-W-029	-	HT CABLE JOINTING & TERMINATIONS KIT-TYPE TESTS REPORT.	FGD	-	I	Auto Archive
118	011-109(4)-PVE-W-039	-	Type Test Report for LT Control cable	FGD	-	I	Auto Archive
119	011-109(4)-PVE-W-070	-	Type Test Report of Segregated Phase Busduct	FGD	-	I	Auto Archive
120	011-109(4)-PVE-Y-001	-	Datasheet, GA and curves for LT Motors (FURTHER BREAK UP NECESSARY)	FGD	-	I	Auto Archive
121	011-109(4)-PVE-Y-018	-	Datasheet and Cross Section Drawings for LT Control Cables	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
122	011-109(4)-PVE-Y-021	-	GA & DATASHEET FOR LIGHTING PANELS (LP1, LP2, LP3 & LPD TYPE)	FGD	-	I	Auto Archive
123	011-109(4)-PVE-Y-050	-	Datasheet for Earthing & Lightning Materials	FGD	-	I	Auto Archive
124	011-109(4)-PVI-B-001	-	IO ASSIGNMENT , GA / IA SYSTEM, MARSHALLING/RELAY and REMOTE CABINET ALONG WITH BOM	FGD	-	I	Auto Archive
125	011-109(4)-PVI-B-005	-	Drawing & Datasheet of LIE/LIR	FGD	-	I	Auto Archive
126	011-109(4)-PVI-B-007	-	GA, Datasheet and Wiring diagram of Limestone Sampling System Local Control Panel	FGD	-	I	Auto Archive
127	011-109(4)-PVI-B-008	-	GA and Wiring Oxidation Blower Local Control Panel	FGD	-	I	Auto Archive
128	011-109(4)-PVI-F-001	-	FIELD BUS SEGMENTATION AND LOOP DIAGRAM ALONG WITH TERMINATION DETAILS	FGD	-	I	Auto Archive
129	011-109(4)-PVI-F-002	-	DATASHEET FOR FIELD BUS CABLES	FGD	-	I	Auto Archive
130	011-109(4)-PVI-G-001	-	Instrument list	FGD	-	I	Auto Archive
131	011-109(4)-PVI-H-001	-	Cable Schedule for power, control & instrument cables.	FGD	-	I	Auto Archive
132	011-109(4)-PVI-P-001	-	Control system Functional Grouping	FGD	-	I	Auto Archive
133	011-109(4)-PVI-Q-001	-	Installation Scheme, Instrument wiring and tubing diagrams (hook up)	FGD	-	I	Auto Archive
134	011-109(4)-PVI-V-001	-	FGD control system Graphics and Mimics	FGD	-	I	Auto Archive
135	011-109(4)-PVI-W-003	-	Type Test Report of FGD control System	FGD	-	I	Auto Archive
136	011-109(4)-PVI-W-021	-	LIE/LIR & JB Grouping	FGD	-	I	Auto Archive
137	011-109(4)-PVI-W-026	-	ATST REPORT-FGD CONTROL SYSTEM	FGD	-	I	Auto Archive
138	011-109(4)-PVI-Y-001	-	Data sheets and type test for Instrumentation, control optical fiber Cable.	FGD	-	I	Auto Archive
139	011-109(4)-PVI-Y-012	-	Data Sheet of Operator Desk and Computer furniture	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
140	011-109(4)-PVI-Y-020	-	Datasheet & GA Drawing of Temperature Element with Thermowell	FGD	-	I	Auto Archive
141	011-109(4)-PVI-Y-023	-	Datasheet & GA Drawing of Ultrasonic Level Transmitter	FGD	-	I	Auto Archive
142	011-109(4)-PVI-Y-025	-	Datasheet & GA Drawing of Flow Meter	FGD	-	I	Auto Archive
143	011-109(4)-PVI-Y-029	-	DATA SHEET, GA DRAWING, TRANSDUCER MOUNTING DRAWINGS, JB DRAWINGS, CONFIGURATION DRAWING, BOM & TYPE TEST REPORT FOR VIBRATION MONITORING	FGD	-	I	Auto Archive
144	011-109(4)-PVI-Y-030	-	GI RIGID CONDUITS & ACCESSORIES - OUTLINE DIMENSION, GA DRAWINGS & DATASHEET	FGD	-	I	Auto Archive
145	011-109(4)-PVI-Y-031	-	Drawing and Datasheet for Universal HART Communicator	FGD	-	I	Auto Archive
146	011-109(4)-PVI-Y-037	-	GA OF Wet Stack INDICATING SAMPLING PORT/ TAPPINGS FOR FLUE GAS ANALYSERS (CEMS MEASUREMENTS)	FGD	-	I	Auto Archive
147	011-109(4)-PVI-Y-038	-	Commissioning procedure/manual for CEMS.	FGD	-	I	Auto Archive
148	011-109(4)-PVI-Y-040	-	Erection drawing including erection procedure for CEMS	FGD	-	I	Auto Archive
149	011-109(4)-PVI-Y-041	-	GA, Datasheet, SLD for UPS and battery-230 VAC	FGD	-	I	Auto Archive
150	011-109(4)-PVI-Y-042	-	GA, Datasheet, SLD for Charger and battery-24DC	FGD	-	I	Auto Archive
151	011-109(4)-PVM-B-020	-	GA & Data sheet of Primary & Secondary Dewatering Hydrocyclone	FGD	-	I	Auto Archive
152	011-109(4)-PVM-B-021	-	General Arrangement of Limestone Day Silos	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
153	011-109(4)-PVM-B-034	-	Data sheet & General Arrangement of Agitators (Horizontal & Vertical) for Absorber Reaction Tank & all other tanks	FGD	-	I	Auto Archive
154	011-109(4)-PVM-B-058	-	General Arrangement & Data Sheet of Limestone Weigh Feeder	FGD	-	I	Auto Archive
155	011-109(4)-PVM-B-059	-	Documents for Seal Air System of Guillotine Damper	FGD	-	I	Auto Archive
156	011-109(4)-PVM-B-060	-	GA & Data Sheet for Air Cannon	FGD	-	I	Auto Archive
157	011-109(4)-PVM-B-066	-	GA & Data Sheet for Butterfly Valves,Globe, Ball,Gate	FGD	-	I	Auto Archive
158	011-109(4)-PVM-B-081	-	G.A. OF TYP. CHUTE & SKIRT	FGD	-	I	Auto Archive
159	011-109(4)-PVM-B-085	-	COASTING TIME CALCULATION	FGD	-	I	Auto Archive
160	011-109(4)-PVM-B-094	-	G.A OF GEARBOX FOR CONVEYORS	FGD	-	I	Auto Archive
161	011-109(4)-PVM-B-095	-	G.A of High Speed and Low Speed Couplings	FGD	-	I	Auto Archive
162	011-109(4)-PVM-B-096	-	G.A & DATA SHEET OF ELEVATOR FOR LIMESTONE CRUSHER HOUSE	FGD	-	I	Auto Archive
163	011-109(4)-PVM-B-100	-	GA OF RACK & PINION GATE	FGD	-	I	Auto Archive
164	011-109(4)-PVM-B-105	-	G.A OF BRAKES FOR CONVEYORS	FGD	-	I	Auto Archive
165	011-109(4)-PVM-B-111	-	GA OF SCRAPPERS- INTERNAL & EXTERNAL	FGD	-	I	Auto Archive
166	011-109(4)-PVM-B-115	-	GA and data sheet of centrifugal fan FOR Ventilation system & DE	FGD	-	I	Auto Archive
167	011-109(4)-PVM-B-116	-	GA and data sheet of EHT Rail Clamp for Travelling Tripper	FGD	-	I	Auto Archive
168	011-109(4)-PVM-B-117	-	GA and data sheet of Brake for Travelling Tripper	FGD	-	I	Auto Archive
169	011-109(4)-PVM-B-139	-	G.A OF ELECTRIC HOIST	FGD	-	I	Auto Archive
170	011-109(4)-PVM-B-140	-	G.A OF MANUAL HOIST/ CHAIN PULLEY BLOCK (MORE THAN 5T)	FGD	-	I	Auto Archive
171	011-109(4)-PVM-B-169	-	GA of Weigh Bridge for Truck Tippler	FGD	-	I	Auto Archive
172	011-109(4)-PVM-B-189	-	G.A & Duct Layout -DE System	FGD	-	I	Auto Archive
173	011-109(4)-PVM-B-206	-	General Arrangement for Cake wash Pump	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
174	011-109(4)-PVM-B-207	-	GA & Datasheet of Condensate System of Chimney	FGD	-	I	Auto Archive
175	011-109(4)-PVM-B-234	-	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT AND ERECTION & APPLICATION DETAIL OF INSULATION	FGD	-	I	Auto Archive
176	011-109(4)-PVM-B-236	-	P&I DIAGRAM FOR AIR Compressor	FGD	-	I	Auto Archive
177	011-109(4)-PVM-B-237	-	P&I DIAGRAM FOR AIR Dryer	FGD	-	I	Auto Archive
178	011-109(4)-PVM-B-240	-	G.A. OF DELUGE VALVE HOUSING & VALVE CHAMBER	FGD	-	I	Auto Archive
179	011-109(4)-PVM-B-242	-	TDS and GA OF Chain Pulley Block	FGD	-	I	Auto Archive
180	011-109(4)-PVM-B-243	-	Data Sheet - Pipes & Fittings (MS & GI)	FGD	-	I	Auto Archive
181	011-109(4)-PVM-B-244	-	Data Sheet of Wrapping & Coating Material	FGD	-	I	Auto Archive
182	011-109(4)-PVM-B-245	-	Data Sheet - Valves (Gate Valve, Manual & Motorised Butterfly Valve)	FGD	-	I	Auto Archive
183	011-109(4)-PVM-B-246	-	Data Sheet - Hydrant Valve	FGD	-	I	Auto Archive
184	011-109(4)-PVM-B-247	-	Data Sheet - Hose & Coupling	FGD	-	I	Auto Archive
185	011-109(4)-PVM-B-248	-	Data Sheet - Branch Pipe and Nozzle	FGD	-	I	Auto Archive
186	011-109(4)-PVM-B-249	-	Data Sheet - Hose Boxes	FGD	-	I	Auto Archive
187	011-109(4)-PVM-B-250	-	Data Sheet - Deluge Valve with Trims	FGD	-	I	Auto Archive
188	011-109(4)-PVM-B-251	-	Data Sheet - HWV / MVW Spray Nozzle	FGD	-	I	Auto Archive
189	011-109(4)-PVM-B-252	-	Data Sheet - Quartzoid Bulb Detectors / Sprinklers	FGD	-	I	Auto Archive
190	011-109(4)-PVM-B-253	-	Data Sheet - Fire Extinguishers and Schedule of Fire Extinguisher	FGD	-	I	Auto Archive
191	011-109(4)-PVM-B-260	-	VENTILATION FAN SCHEDULE & TECHNICAL DATA SHEET & G.A. DRAWING OF AXIAL AIR FANS FOR A/C & VENTILATION SYSTEM ALONGWITH FIXING DETAILS	FGD	-	I	Auto Archive
192	011-109(4)-PVM-B-261	-	GA OF SUPPLY/RETURN AIR DIFFUSER/GRILL FOR A/C & VENTILATION SYSTEM	FGD	-	I	Auto Archive

S.NO.	NTPC_DRG_NO	VENDOR_DRG_NO	DRG_TITLE	SUB-SYSTEM	BOI Name	CAT	CUSTODIAN
193	011-109(4)-PVM-B-262	-	TECHNICAL DATA SHEET FOR SPLIT AIR CONDITIONERS	FGD	-	I	Auto Archive
194	011-109(4)-PVM-B-263	-	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR A/C & VENTILATION SYSTEM	FGD	-	I	Auto Archive
195	011-109(4)-PVM-B-265	-	OPERATION & MAINTENANCE MANUAL FOR A/C & VENTILATION SYSTEM	FGD	-	I	Auto Archive
196	011-109(4)-PVM-B-267	-	O&M MANUAL-COMPRESSED AIR SYSTEM	FGD	-	I	Auto Archive
197	011-109(4)-PVM-B-268	-	Operation & Maintenance Manual Fire Detection and Protection System	FGD	-	I	Auto Archive
198	011-109(4)-PVM-F-010	-	GA and Datasheet for Equipment Closed Water Cooling System	FGD	-	I	Auto Archive
199	011-109(4)-PVM-H-002	-	Valve Schedules including LHS & GHS	FGD	-	I	Auto Archive
200	011-109(4)-PVM-H-003	-	Pipe Schedule including LHS & GHS	FGD	-	I	Auto Archive
201	011-109(4)-PVM-L-038	-	General Arrangement for Piping - FGD area (Absorber, Recycle Pump, Aux storage tank area etc)Lime Preparation Area (Ball Mill & Lime handling area etc)	FGD	-	I	Auto Archive
202	011-109(4)-PVM-L-040	-	General Arrangement for Piping - Dewatering area (Belt filter and Hydrocyclone area etc)	FGD	-	I	Auto Archive
203	011-109(4)-PVM-U-015	-	Sizing Calculation of Limestone day silo	FGD	-	I	Auto Archive
204	011-109(4)-PVM-U-021	-	Sizing Calculation for Primary & Secondary Hydro-cyclone	FGD	-	I	Auto Archive
205	011-109(4)-PVM-Y-009	-	Data Sheet for Spray Nozzles	FGD	-	I	Auto Archive

SUB-SECTION-II-E21

ELECTRICAL WORKS FOR CHIMNEY

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS			
		TECHNICAL SPECIFICATION FOR ELECTRICAL WORKS FOR CHIMNEY 1.00.00 INTENT OF SPECIFICATION The following specification shall be applicable to all the electrical equipment furnished and erected under this specification. Items of work not specifically stated in this specification but which are necessary for meeting the requirements of this specification shall be included in the scope. 2.00.00 SCOPE OF WORK 2.01.00 The Contractor shall include in his scope of work the design, engineering, manufacture, supply, erection, testing and commissioning of the following equipment / system complete with all materials and accessories for each chimney: i) Main distribution board, emergency distribution board, elevator board, power, lighting panels and DBs. ii) All lighting fixtures and socket outlets with complete wiring. iii) Aviation Obstruction lighting system. iv) Power and control cables. v) Cabling system. vi) Lightning protection system. vii) Earthing system. viii) Communication system. 2.02.00 The Contractor shall provide 1 No., 415 volt, 3 phase, 4 wire feeder for power supply connection to main distribution board located at chimney base for further distribution of power. 2.03.00 In addition to the above the Contractor shall also provide one No. 415 volt, 3 phase, 3 wire emergency power supply for emergency distribution board located at chimney base. This board shall also receive one feeder from main distribution board described above. Contractor shall provide auto-change over supply to healthy source on failure of any source. 2.04.00 The details of the power supply are given below. The Contractor shall furnish the equipment to suit the same.		
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	a) 415 volt System (normal) i) System voltage 415 $\pm$10% V, three phase and 4 wire neutral solidly earthed ii) System frequency 50 $\pm$ 5% Hz iii) Combined voltage and Frequency variation 10% iv) Fault Level 50 KArms(105 KA peak)/1 sec b) 415 volt System (emergency) i) System voltage 415 $\pm$10% V three phase and three wire system. ii) System frequency 50 $\pm$ 5% Hz iii) Combined voltage and frequency variation 10% iv) Fault Level 50 kA c) In case any power supply other than 415 V, 3 phase indicated above is required, the transformation for same shall be included in the Contractor's scope of work. 2.05.00 Not used. 2.06.00 All bought out electrical equipment like cables, distribution boards/panels, conduits, lighting fixtures, power receptacles, aviation lighting etc. shall be from reputed manufacturers who have manufactured and supplied equipment of the type and rating specified and this equipment should have been in successful operation in chimneys and other structures under similar service conditions. The sub vendors list and makes of all equipment/devices shall be subjected to Owner's approval. 3.00.00 STANDARDS AND REGULATIONS 3.01.00 The equipment supplied shall comply with the relevant IS Standards. All standards, specifications and codes of practice referred to herein shall be the	
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3.02.00	latest editions including all applicable official amendments and revision as on date of opening of bid.			
	The electrical equipment/installations shall comply with the requirements of the following Rules/ Regulations as amended up to date:			
	i) The Indian Electricity Rules/Acts.			
	ii) National Electrical codes and Indian standards.			
	iii) International Civil Aviation organisation Regulations.			
	iv) National Airport Authority/DARA Regulations.			
4.00.00	GENERAL REQUIREMENTS			
4.01.00	Ambient Conditions			
	The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney. Ambient temperature for design of all equipment shall be considered as 55 degrees C which is likely to be encountered during service when the chimney is in full operation.			
4.02.00	The successful Bidder shall be required to carry out the detailed engineering such as:			
	a) Preparation of detailed wiring/schematic diagrams for distribution boards and lighting panels/DBs.			
	b) Preparation of conduit/cable layouts and conduit/ cable schedule.			
	c) Preparation of detailed lighting layout drawings.			
	d) Preparation of detailed wiring / layout drawings for aviation obstruction lighting system.			
	e) Preparation of detailed earthing and lightning protection system drawing.			
	f) Preparation of mounting detail drawings for various equipments.			
	g) Preparation and submission of all approved drawings duly marked up, to reflect the ‘as built’ status, along with reproduceables.			
4.03.00	The successful bidder shall submit the following documents for all the equipments/items being supplied :			
	a) Technical particulars and catalogues			
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	b) Routine & Type Test reports c) Instruction manual for storage, unpacking, handling at site, erection, precommissioning etc. d) Operation & Maintenance Manual			
5.00.00	TECHNICAL REQUIREMENTS			
5.01.00	Distribution boards/Elevator board/Power panels			
5.01.01	Distribution Board shall be of metal enclosed, single front, indoor, floor mounted, free standing, fixed type conforming to IS 13947-PART-I. The Elevator board & Power panels shall be of floor/wall mounted type. The equipment shall be supplied fully assembled and wired, complete with base frame and anchoring arrangement, gland plates, internal wiring, terminal blocks and suitable for termination of external power and control cables. Overall height of Board shall not exceed 2450 mm. All board frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plates thickness shall be 3.0 mm (minimum) for hot/cold-rolled sheet steel and 4.0 mm (minimum) for non-magnetic material. All panels shall be dust and vermin proof.			
5.01.02	The Board shall be divided into distinct vertical sections, each comprising of : i) A completely enclosed busbar compartment for running horizontal and vertical busbars. ii) Completely enclosed switchgear compartment(s) one for each circuit of outgoing feeder. iii) A cable alley for power and control cables of 250 mm width. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations in cable alley shall be designed to meet Form IVb Type & (as per IEC 60439) for safety. The front of the compartment shall be provided with hinged single leaf door with locking facility.			
5.01.03	Boards shall be provided with phase & neutral busbars along entire length of board. The minimum air clearance between live parts shall be 25mm for busbars and 10mm elsewhere both for phase to phase and phase to earth. Wherever such clearance is not available, the live parts shall be fully insulated/shrouded.			
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	However for busbars minimum 25mm air clearance shall be maintained irrespective of insulated/shrouded busbars are provided. 5.01.04 All busbars shall be adequately supported by non-hygroscopic, non combustible, track-resistance and high strength sheet moulded compound or equivalent type polyester fiber glass moulded insulators. Temperature rise of busbars & contacts when carrying rated current along the full run shall not exceed 55 deg.C with silver plated joints and 40 deg.C with all other type of joints over an outside ambient of 50 deg.C. Busbars and jumper connections shall be of high conductivity aluminium alloy / copper. 5.01.05 Paint shade for DBs & panels excluding end covers shall be RAL 9002 & shall be RAL 5012 for extreme end covers. 5.01.06 Boards shall be designed for IP 52 degree of protection. 5.01.07 Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type, complying with IS 13947 PART-3. Incoming switches shall have door interlocks and pad locking facility. Fixed contacts shall be of shrouded type. Switches shall be of AC 22 utilisation category. 5.01.08 All fuses shall be of HRC type with operation indicator, and shall be of suitable rating conforming to IS 9224. They shall be mounted on fuse carriers. Isolating switches shall be of AC 23A category when used in motor circuit & AC 22A category for other applications. Fuse switch combination shall be provided wherever possible. 5.01.09 Contactors shall be of air break, electromagnetic type suitable for DOL starting of motors and shall be of utilization category AC-3 for ordinary & AC-4 for reversing starters. Nominal coil voltages of contactors shall be as required. AC contactors shall operate satisfactorily between 85% to 110% of the voltage. DC contactors shall be of DC-3 category. 5.01.10 Current transformers shall be completely encapsulated, cast resin insulated type, having accuracy class of 1.0 conforming to IS 2705. 5.01.11 Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. Ammeter and voltmeter selector switches shall have four stay-put positions with adequate number of contacts for three phase 4-wire system. 5.01.12 Indicating lamps shall be cluster LED type. Bulbs and lamp covers shall be easily replaceable from front of the panel. 5.01.13 All indicating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales and shall have an accuracy class of 2.0 or better.			
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5.01.14	Miniature circuit breakers (MCB's) shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have interrupting capacity of 9 KA rms. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held in ON position. MCB terminal shall be shrouded to avoid accidental contact. It shall conform to IS 8828.			
5.01.15	Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plates shall be provided at front and rear. All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black back ground. Inscription and lettering sizes shall be subject to Owner's approval. Labels for fuses shall also clearly indicate current ratings of the respective fuses. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the wiring drawings.			
5.01.16	All internal control wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger, stranded copper wires having color - coded, PVC insulation. Space heater / power circuits shall have wires having adequate current carrying capacity, but not less than 2.5 sq.mm Copper. Internal terminals of stranded conductors shall be made with solderless crimping type tinned copper lugs. Insulating sleeves shall be provided over the exposed part of lugs. Engraved core identification ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire. Jumper wires between two terminal blocks shall also be ferruled at both ends.			
5.01.17	A continuous galvanised steel grounding bus of 50 mm x 6 mm size shall be provided along the bottom of the panel structure. It shall run continuously through out the length of the panel and shall have provision at both ends for connection to the grounding grid. Metallic parts of all components shall be effectively earthed using green colored insulated copper wire or other approved means. Electrical continuity of the whole enclosure/frame work shall be maintained even after painting. All hinged doors shall be earthed through flexible earthing braids of copper.			
5.01.18	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply and shall be automatically controlled by thermostat. Each free standing panel section shall have a 240 V AC, plug point and a light operated by door switch. Necessary isolating MCBs shall also be provided for protection.			
5.01.19	All sheet steel work shall be pretreated in tanks in accordance with IS 6005. The phosphated surfaces shall be rinsed and passivated, given a stoved lead oxide primer coating, followed by two coats of finishing synthetic enamel paint. Each coat of primary and finishing paint shall be of slightly different shade to enable inspection of painting. Finishing paint on panels exterior shall be shade RAL-9002 unless required otherwise by the Owner. The inside of the panels shall be glossy white.			
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5.01.20	Terminal blocks shall be of 1100V grade, rated for cable ampacity, in one piece moulding, complete with insulating carriers, terminals and identification strips. For control circuits it shall be of Klippon type and for power circuits it shall be of stud type.			
5.01.21	Typical details of Feeders of Main distribution board, Emergency distribution board, Elevator board & Power panels etc. are shown in the enclosed drawings. However, No. and size of Distribution boards/panels/feeders shall be as per actual requirement.			
5.01.22	Lighting transformers shall be dry type, natural air cooled epoxy insulated. Impedance of lighting transformer shall be so selected that the fault level of lighting system shall be reduced to 3 to 5 kA. Lighting transformers shall be tested as per IS:2026. Off-circuit tap changer with +/- 2.5% and +/- 5% tapping shall be provided. In case the transformers are not mounted inside the DB, the same shall be housed in a separate 2 mm thick CR sheet steel enclosure with IP-42 degree of protection as per IS:2147. However, the transformer terminal box shall have IP-52 degree of protection.			
5.02.00	Lighting Panels (LP) / Distribution Boards (DB)			
5.02.01	Lighting panel / DBs shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel / DB shall be gasketed to achieve IP:55 degree of protection. The panel / DB shall be provided with terminal blocks for incoming and outgoing circuits, earthing terminals, M.S. mounting brackets suitable for surface mounting on wall/column/structure, allen keys with bolts as locking arrangements, circuit directory plate & circuit diagram fitted on the inside of the door etc. Removable gland plates shall be provided for top/bottom entry of cables/conduits.			
5.02.02	Wiring inside the panel / DB shall be carried out with 1100 V grade PVC insulated stranded copper conductors of adequate size. On both ends of each wire engraved identification ferrules shall be provided.			
5.02.03	Busbar shall be of Aluminium alloy / copper conforming to clauses 5.01.03 & 5.01.04.			
5.02.04	All MCB's/Isolators etc. shall be mounted inside the panel / DB and an inner bakelite sheet/fibre glass sheet shall be provided inside such that operating knobs of MCBs etc. project out of it for safe operation against accidental contact. Operating handle of Incoming Isolator shall project out of door.			
5.02.05	Equipment mounted inside the panel / DB shall be provided with individual labels with equipment designation/rating. Front of the panel / DB shall be provided with label engraved with designation of the panel / DB as furnished by the owner. Labels shall be made of 3 ply lamicoid/engraved PVC having white letters on black background.			
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5.02.06	Terminal blocks shall be 1100 V grade, stud type, moulded in melamine, suitable for terminating incoming cable and outgoing circuit of specified size. All the terminals shall be shrouded, numbered and provided with identification strip for the feeders.												
5.02.07	Miniature Circuit Breaker and isolator shall of same type as specified under cl. 5.01.14. Other features of the panel / DB shall be same as that of distribution board.												
5.03.00	Lighting System												
5.03.01	The lighting system shall provide adequate illumination at various platforms, stairways, landing and other areas of the chimney.												
5.03.02	The following average illumination levels shall be achieved and guaranteed by the contractor after considering maintenance factor of not more than 0.6 : <table><tr><td>a)</td><td>On equipment</td><td>150 Lux</td></tr><tr><td>b)</td><td>General platform area</td><td>70 Lux</td></tr><tr><td>c)</td><td>Stairways and landings</td><td>100 Lux [minimum one (1) light fixture at each landing].</td></tr></table> Any additional fixtures to take care of dark patches/shadows shall also be provided.				a)	On equipment	150 Lux	b)	General platform area	70 Lux	c)	Stairways and landings	100 Lux [minimum one (1) light fixture at each landing].
a)	On equipment	150 Lux											
b)	General platform area	70 Lux											
c)	Stairways and landings	100 Lux [minimum one (1) light fixture at each landing].											
5.03.03	Power supply for normal lighting system shall be obtained through main distribution board. 80% lighting at various platforms and 50% lighting in staircases shall be fed from normal A.C. source. 20% lighting at various platforms and 50% lighting on staircases shall be fed from emergency AC supply. Emergency AC supply shall be obtained from emergency distribution board.												
5.03.04	Lighting fixtures shall be suitable for continuous operation under atmospheric condition prevailing at chimney. Lighting fixtures shall be suitable for operation on 240V, AC, 50 Hz. supply with voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ and combined voltage and frequency variation of 10%.												
5.03.05	Lighting fixtures shall be dust tight LED, well glass fixtures.												
5.03.06	Lighting fixtures shall be designed for IP:55 degree of protection. Power factor shall not be less than 0.85. Ballast shall be of copper wire wound type. Ballast shall include radio interference suppressors. LED lamps shall have screwed cap. All lighting fixtures shall be adequately earthed with galvanised steel wire.												
5.03.07	3 Pin Receptacles designed for IP:55 degree of protection shall be provided at every platform level, rated for 20A, 240 V,AC. The Receptacles shall be complete with 20A, 240V, AC switch and 3 pin plug.												
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5.03.08	Heavy duty welding Receptacle with ELCB rated for 415V, AC, 63A shall be provided at each internal platform level. They shall be metal clad, shrouded diecast aluminium designed for IP:55 degree of protection. The Receptacle unit shall be complete with 63 A, AC 23 category switch unit, plug and safety lid cover.			
5.03.09	The Receptacle shall be wall mounted type with bolted front cover and removable gland plate. The Receptacle shall be interlocked such that, a) Switch can be put ON only when the plug is fully engaged. b) Plug can be with drawn only when the switch is in OFF position. c) Covers can be opened only when the switch is in OFF position.			
5.03.10	Conduits/pipes shall be complete with fittings and accessories. The size of conduit pipe shall be selected on the basis of maximum 40% fill criteria. Minimum size of the conduit shall not be less than 19mm. Conduits shall be of rigid steel type suitable for heavy mechanical stresses conforming to IS 9537, threaded on both sides and shall be hot dip galvanised. All conduit accessories shall also be hot dip galvanised.			
5.03.11	Flexible steel conduits shall be water proof and rust proof made of heat resistant lead coated steel.			
5.03.12	Junction boxes and pull boxes shall be made of CRCA sheet steel of 1.60 mm thickness and shall be hot dip galvanised. It shall be designed for IP:55 degree of protection. Junction boxes shall incorporate terminal blocks for termination of incoming and outgoing cables.			
5.03.13	Lighting wires shall be of 1100V grade, PVC insulated, stranded copper/Aluminium conductor conforming to IS 694. Lighting wires shall be terminated using solderless crimping type copper lug. Minimum size of wire shall not be less than 1.5 sq.mm in case of copper and 4 sq.mm in case of aluminium. The size of the lighting wire/cables shall be selected such that total voltage drop from LDB to lighting fixture/receptacle does not exceed 3%.			
5.04.00	Cables			
5.04.01	Power cables shall be 1100 volt grade, multicore FRLS-HRPVC/XLPE insulated, PVC inner sheathed, armoured PVC outer sheathed, stranded copper/Aluminium conductor conforming to IS-1554-I.			
5.04.02	Control cables shall be of 1100 volt grade, multicore, FRLS-HRPVC/XLPE insulated, PVC inner sheathed, armoured, PVC outer sheathed, stranded copper conductor conforming to IS-1554-I.			
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5.04.03	FRLS properties for power and control cables shall be as follows: a) Oxygen index Min. 29 (As per ASTM D - 2863) b) Acid gas generation: Max 20% (As per 2863) c) Smoke density rating: 60% (As per ASTM D - 2843)			
5.04.04	Following factors shall be considered in sizing the cables : a) Continuous current carrying capacity b) Voltage drop c) Short circuit capacity d) Ambient temperature condition prevailing in chimney e) Cable grouping factors			
5.04.05	Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm aluminium. Maximum voltage drop between main distribution board and final equipment shall be limited to 3% when carrying full load current. Cable sizing calculations shall be submitted for approval. Minimum size of control cable shall not be less than 1.5 sq.mm.			
5.04.06	Cables shall meet the testing requirements as per IS.			
5.04.07	Cables shall be terminated using double compression type cable gland and tinned copper solderless crimping type lug. Cable glands shall be heavy duty, brass machine finished conforming to BS:6121.			
5.04.08	Cable trays and accessories shall be of ladder type, hot dip galvanized, made of minimum 2.0 mm thick sheet steel.			
5.05.00	Aviation obstruction lighting system			
5.05.01	Aviation obstruction lighting system shall conform to the requirements of the latest applicable rules of International civil aviation organization (ICAO) and NAA/DARA regulations.			
5.05.02	The aviation obstruction lighting system shall be of high intensity type.			
5.05.03	The system shall be suitable for operation on 240V $\pm$ 10% single phase, 50 Hz, AC supply.			
5.05.04	Photo electric controller shall be housed in rugged weather tight, IP 65 enclosure. LED's shall be provided to indicate the operation status of the unit.			
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5.05.05	System controller shall be suitable for operation at specified ambient temperature and shall be wall mounted type. The enclosure shall have IP:55 degree of protection.			
5.05.06	Aviation obstruction light unit shall provide easy access to lamp and components.			
5.05.07	Four nos. of obstruction lights shall be installed at each specified elevation. The system controller is proposed to be located at 1.2 metre elevation and photo electric controller at about 40 metre elevation. Necessary cables for wiring between photocell & system controller and between system controller & obstacle lights shall be provided. Typical aviation obstruction lighting system arrangement is shown in the enclosed tender drawing.			
5.05.08	Each item shall be preassembled, routine tested optically and electrically before shipment.			
5.05.09	Bidder shall furnish the complete routine test report of the fixtures, controllers, photocells etc. Testing of aviation lights as per ICAO regulations to be carried out and routine test report to be submitted.			
5.05.10	High intensity obstacle lights shall meet the following requirements.			
	(a)	It shall be flashing white light. The effective intensity of obstacle light shall be variable and dependent on background luminance as follows.		
		Background luminance	Effective Intensity	
	(i)	Above 500 cd/m2	200000 cd minimum	
	(ii)	50 to 500 cd/m2	20000 ± 25% cd	
	(iii)	Less than 50 cd/m2	4000 ± 25% cd	
	(b)	The obstacle lights shall flash simultaneously at a rate between 40 to 60 per minute.		
	(c)	Obstacle lights shall have a day time effective intensity of minimum 200000 cd. The intensity of lights shall reduce automatically to 20000 cd ± 25% at twilight through the use of photocell and again automatically to a night time intensity of 4000 cd ± 25% through the use of photo- cell.		
	(d)	The system shall also provide automatic sensing and display of system status and aviation lamp failure detection.		
	5.05.11	The distance between lighting elevations shall not be more than 105 Metre and lowest lighting elevation shall not be less than 70 metre.		
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5.05.12	The light unit shall have adjustable bracket with level indicator to ensure accurate vertical placement of the light flash.			
5.05.13	Temporary obstruction lighting shall be provided during construction. Obstruction lights shall be provided on the uppermost part of the chimney, or the surrounding scaffolding. As construction progresses each completed level shall be provided with temporary lighting. Temporary obstruction lights shall have four fixtures located in a horizontal plane on the chimney structure to ensure unobstructed visibility of at least one obstruction light from aircraft at any normal angle of approach. Power for operation of the temporary obstruction lights shall be obtained from the construction power system. Supply circuit for these lights shall be furnished, installed and maintained by the Contractor. Temporary obstruction lights shall be operated from sunset to sunrise during each day of the contract period until such time as the Engineer issues instructions in writing to discontinue.			
5.06.00	Earthing			
5.06.01	Earthing system shall conform to IEEE 665 and IS 3043. Earth grid system for chimney shall consist of horizontal conductors and vertical conductors. Horizontal conductor shall be of 40mm dia mild steel rod buried at a depth of 1 metre all around the chimney. Vertical rods shall be of 40 mm dia, 3 metre long mild steel driven deep in to the ground and also connecting to horizontal conductor at 20 metre interval. The chimney earth grid system shall be interconnected with main plant earth grid at minimum 2 points, through bolted removable link and earth pits.			
5.06.02	Metallic enclosures of all electrical equipments shall be earthed by two separate and distinct connections to earth grid system. The earth connections shall consist of galvanised steel strip/rod/wire, sized adequately to carry the earth fault current of the system. Two nos. main earthing conductor shall be run inside all along chimney height. Electrical equipments at every platform shall be earthed with this conductor. Cable armour shall be bonded to earthing system at both ends of the circuit. The earthing conductors and accessories located at top 12m level shall have lead cover of minimum 2mm thickness. The accessories like nuts, bolts, dash fasteners, round clamps, washers etc. to be used for top 12m level shall be made of stainless steel.			
5.06.03	Steel structures, metallic pipes etc. shall also be connected to earthing system. Connections between earthing conductor and equipments shall be of bolted type only. Earthing conductors along their run on walls shall be supported by cleating at 1 metre interval. Clamps and hardware shall be of compatible material. Minimum size of earthing conductor shall not be less than 14 SWG G.S wire. Earthing conductor shall also be run along with cable ways / each conduit run.			
5.06.04	The contractor shall provide and maintain a temporary earthing system as per attached tender drawing until permanent earthing system is installed.			
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5.07.00	Lightning Protection System			
5.07.01	Lightning protection system shall conform to IEC-62305. It shall comprise vertical air termination, horizontal air termination, down conductor, test links, earth connections and earth electrodes.			
5.07.02	Vertical air termination shall extend 3 metre above the top of the chimney. For each flue duct, 3 nos. vertical air terminations shall be provided. Vertical air termination shall be of 20mm dia copper rod with lead cover of 2 mm thickness.			
5.07.03	Horizontal air terminations(coronal bond) shall be of minimum 50x6 mm galvanised steel strips provided at following levels. a) Top level of each flue b) Roof top level around outer concrete shell c) Mid height around concrete shell			
5.07.04	Horizontal air terminations and vertical air terminations shall be inter connected by down conductors. No. of down conductors shall be minimum 4, equally spaced around and on exterior surface of concrete shell. Down conductors shall be of minimum 50x6 mm galvanised steel strip. Down conductors shall additionally be connected to vertical reinforcement rods at top and bottom of chimney at minimum four locations. Suitable precaution shall be taken at these joint connections to prevent any galvanic action. Reinforcement bars shall be made electrically continuous throughout their height.			
5.07.05	Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure.			
5.07.06	Below the test link, direct connection with 40 mm dia mild steel rod shall be made to the earth grid system. Adequate no. of vertical electrodes of 40mm dia mild steel shall be provided to obtain required earth resistance.			
5.07.07	Down conductors shall not be connected to other earthing conductors above ground level. To avoid side flashing, metallic structures like hand rails, stairs etc.in the vicinity of down conductor shall be bonded to lightning protection system.			
5.07.08	Air terminations, down conductors, coronal band and accessories located at top 12 m level shall have lead cover of 2mm thickness. Suitable bimetallic washers shall be used while connecting conductors of different materials. The accessories like nuts, bolts, dash fasteners, round clamps, washers etc., to be used for top 12 metre level shall be made of stainless steel.			
5.07.09	Down conductors and horizontal air terminations shall be cleated to concrete structure at 750 mm interval.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. :CS-0011-109(4)-2	SUB-SECTION-II-E-21 ELECTRICAL WORKS FOR CHIMNEY	PAGE 13 OF 17

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS			
5.07.10	The contractor shall provide and maintain a temporary lightning protection system as per attached tender drawing until permanent lightning protection system is installed.			
5.08.00	Communication system			
5.08.01	Contractor shall provide telephone cable installed in independent G.I. conduits and wired up to junction boxes with telephone socket at 0.0 M and at every internal platform for connection of telephone handset.			
5.08.02	Telephone cables shall be of minimum 0.6 mm dia annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.			
6.00.00	INSTALLATION			
6.01.00	Equipments/items shall be installed in a neat workmanner so that it is leveled, plumbed, squared and properly aligned and oriented.			
6.02.00	The Contractor shall furnish all supervision, labour, tools, equipment, rigging materials, incidental items such as bolts, wedges, anchors/angles, frames, studs, rawl plugs, concrete inserts etc. required to completely install, test, adjust and fix the equipment.			
6.03.00	Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, erecting, testing and commissioning of all items/equipments and care shall be exercised in handling to avoid distortion to stationary structures, the marring of finish, or damaging of delicate instruments or other electrical parts. All care should be taken to avoid damage of galvanised/painted surfaces during installation. All damaged surfaces of galvanised or ungalvanised faces of steel structures, conduits, junction boxes, trays etc. shall be brushed up and shall be painted with red primer paint followed by two coats of aluminium paint/enamel paint to the satisfaction of Engineer.			
6.04.00	Connections between distribution boards, between distribution board and Elevator board/lighting & power panels and between distribution board/power panels & receptacles shall be carried out with FRLS-HRPVC insulated armoured copper / aluminium cables. Connections between lighting panel and lighting fixture/receptacles and for aviation lighting system shall be carried out with PVC insulated copper / aluminium wires laid in galvanised steel conduit.			
6.05.00	After installation of lighting fixtures/ receptacles/switch boxes, the panel number and circuit number shall be painted on them at a suitable place.			
6.06.00	Wherever non-galvanised steel members/structures are erected, they shall be brushed before giving one coat of lead primer followed by two coats of epoxy			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. :CS-0011-109(4)-2	SUB-SECTION-II-E-21 ELECTRICAL WORKS FOR CHIMNEY	PAGE 14 OF 17

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS			
	paint. All nuts, bolts and washers required for complete installation shall be hot dipped galvanised. 6.07.00 Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. A suitable fool-proof method (preferably using dash fasteners) for fixing these shall be offered and this shall be subject to Owner's approval. 6.08.00 To distinguish emergency AC fixtures from normal AC fixtures, red painted circular mark of 1 cm. dia. shall be provided on emergency fixtures. 6.09.00 Exposed conduits shall run in straight lines. Conduits shall be fixed by using metallic saddles/clamp secured to suitable nylon rawl plugs with screws or secured to the wall/structure at an interval of not more than 1 metre. Notwithstanding the above in case of couplers or similar fittings, saddles/clamps shall be fixed at a distance of 30 cm from the center of such fittings. 6.10.00 All openings in the floor/wall/ceiling etc, made for conduit installation shall be sealed and made water proof. 6.11.00 For long conduit runs pull out boxes shall be provided at suitable intervals (not exceeding 4 m to facilitate wiring. However pull out boxes need not be provided wherever junction boxes exists in circuit. 6.12.00 The entire metallic conduit system whether embedded or exposed shall be electrically continuous and thoroughly grounded. Where slip joints are used, suitable bonding shall be provided among the joint to ensure a continuous ground circuit. G.I. Pull wire of adequate size shall be laid in all conduits before installation. 6.13.00 Each conduit run shall be marked with its designation as indicated on the drawings. Identifications shall be marked by means of painting so that each run of conduit is readily identified at each end. Where conduits terminate at panels, switch boxes, junction boxes, or other enclosures, the designations shall also be painted on the inside of the enclosure adjacent to the conduits. 6.14.00 Wires shall not be pulled through more than two equivalent 90° bends in a single circuit run. Wherever required, suitable conduit junction boxes/pull boxes shall be provided. All types of wiring, concealed or unconcealed shall be capable of easy inspection. 6.15.00 Receptacles and lighting circuits shall be fed from different circuits. The switch controlling these circuits shall be on the live side (phase wire) of the circuits. 6.16.00 A.C. normal & AC emergency wiring shall run throughout, in separate conduits. Wires of different phases shall run in different conduits 6.17.00 Wiring shall be spliced only at junction boxes. Maximum two wires shall be connected at each terminal. In vertical run of wires, in conduit the wires shall be suitably supported by means of hard rubber plugs, at each pull/junction box.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. :CS-0011-109(4)-2	SUB-SECTION-II-E-21 ELECTRICAL WORKS FOR CHIMNEY	PAGE 15 OF 17	

CLAUSE NO.	CHIMNEY ELECTRICAL WORKS			
6.18.00	Cables shall be installed on trays/troughs or cleated to steel work. Cable trays/troughs and supports shall be prefabricated and hot dip galvanised. Cable trays/troughs shall be of ladder/ perforated type constructed of minimum 2mm thick mild steel.			
6.19.00	Cable tray/trough supports shall be fixed by bolting in case of concrete structures and by welding in case of steel structures. Cable trays shall be adequately fastened to supports. Cables shall be cleated/clamped with cable tray/trough on vertical runs at every 1 metre interval. Cables laid on horizontal runs shall be secured to trays with nylon cable ties at every 5 metre interval.			
6.20.00	Wherever cable passes through floor/wall, pipe sleeves shall be provided and shall be properly sealed after laying cable. No joints shall be allowed in any cable run. Power and control cables shall not be laid together. Cable tags shall be provided on all cables at each end, on both sides of floor/wall crossings and at every 20 metre interval in cable tray runs.			
7.00.00	TESTS			
7.01.00	All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below: (A) Distribution boards/panels-Degree of protection tests (B) Aviation lights: (1)Intensity Test (2)Degree of protection test (3)Dust Ingress test The tests must be carried out within last 10 years from date of bid opening on equipment similar to those proposed to be supplied under this contract. The test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the test report(s) are not found to be meeting NTPC requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party laboratory or in presence of Owner's/Client's representative & submit the reports for approval.			
7.02.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
8.00.00	MANDATORY SPARES			
8.01.00	A list of Mandatory Spares parts for Aviation Obstruction Lighting System is described below: (1) Power Supply Card - 6 nos.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO. :CS-0011-109(4)-2	SUB-SECTION-II-E-21 ELECTRICAL WORKS FOR CHIMNEY	PAGE 16 OF 17

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
1.	Sec-VI/Part-B	I-M1	32 of 51	10.01.00	Slurry tanks: Replaceable Chlorobutyl/ Bromobutyl rubber lining of minimum 4 mm thickness	Slurry tanks: Replaceable Chlorobutyl / Bromobutyl rubber lining of minimum 5 mm thickness
2.	SECTION – VI, PART-B	SUB SECTION –I-M1 (FGD)	17 of 51	5.06.06	The mist eliminator wash piping/header shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same.	The mist eliminator wash piping/header shall be constructed of Chlorobutyl / Bromobutyl rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same.
3.	SECTION – VI, PART-B	SUB-SECTION-I-M1 (FGD)	20 of 51	5.06.16	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 are avoided. Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules.	The spray headers (if provided) and air supply headers shall be made of FRP or Carbon Steel with Chlorobutyl / Bromobutyl rubber lining (minimum 10 mm natural rubber lining), corrosions and erosion resistant in the inner and outer side are avoided. Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules.
4.	Part-E, tender Drawing				0011-109(4)-POM-A-003-Rev A	0011-109(4)-POM-A-003-Rev B (Refer Annexure-A4)

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
5.	SECTION-VI PART-C	PART-C GENERAL TECH- NICAL RE- QUIRE MENTS	42 of 83	30.00.00	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	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
6.	Sec- VI/Part-A	I	3 of 19	1.03.07	Low Height Wet Chimney(s) for the project (except Rourkela Project for which the Wet Chimney under construction is to be used)	Clause stand deleted
7.	SECTION- VI, PART- A	SUB- SEC- TION-III- A1 (FGD)	7 of 12	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.	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 15 m) 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.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
8.	SECTION-VI, PART-A	SUB-SECTION-VI	2 of 25	2.02.01	All instruments required for performance PG test procedure shall be done within 180 days from the date of Notification of Award.	All instruments required for performance PG test procedure shall be done within 180 days from the date of Notification of Award. All test instrumentation, Personal computer(s), necessary server and required interface, software for on line computation of test results & report as required for performance guarantee tests shall be supplied by the contractor and shall be retained by the Employer.
9.	VI/ E	Tender Drawings 0011-109(4)-POM-A-001	Sheet no. 2 of 3		SO2 analyser and Flow transmitter cum Indicator (FT+FI) shown in Flue gas duct between absorber and chimney.	SO2 analyser and Flow transmitter cum Indicator (FT+FI) shown in Flue gas duct between absorber and chimney stands deleted.
10.	VI/ A	III-C	1 of 21	1.01.00 (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	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.
FGD SYSTEM PACKAGE LOT-4 PROJECTS					AMENDMENT NO. CS-0011-109(4)-9-AMDT-TECH-01 BID DOCUMENT NO. CS-0011-109(4)-9	Page 3 of 25

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
11.	VI/ A	III-C	2 of 21	1.01.00 (g)	Scope defined in PART-A read in conjunction with PART-B has to be provided for each station under LOT-2 package.	Scope defined in PART-A read in conjunction with PART-B has to be provided for each station under this package.
12.	VI/ A	III-C	13 of 21	3.03.01 (Note 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.	Deleted
13.	VI/A	II- A1/A2/A3	-	Annex- ure-IV	-	Amendment added with clause 7.00.00, II- A1/A2/A3, of Tech. Specification. (Refer Annex- ure-A1, Annexure-A2, Annexure-A3)
14.	SEC- VI PART B	IV-D CIVIL WORKS	6 OF 67	3.05.00	Control building, M. C. C. Buildings These shall be framed building with R. C. C. roof and floor.	Control building, M. C. C. Buildings These shall be steel / RCC framed building with RCC roof and floor.
15.	SEC- VI PART B	IV-D CIVIL WORKS	9 OF 67	3.14.01	Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. 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.	Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. Chimney shall be of reinforced concrete construction. 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.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
16.	SEC- VI PART B	IV-D CIVIL WORKS	10 OF 66	3.14.01	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 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 directly on the chimney shell due to the duct. The flue duct shall be supported on steel structure from the raft of chimney. Alternately, the flue duct can be supported on internal platform resting of wind shield, loads due to flue duct shall be considered in design of Wind Shield. The interface between the flue liner and the transition ducting shall be provided with non-metallic expansion joint.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
17.	SEC- VI PART B	IV-D CIVIL WORKS	11 of 66	3.14.03	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 openings..... less than 500mm. The minimum vertical reinforcement..... Reinforcement shall be 50mm. There Shall not be any reverse.....such slope/profile change level.	The cross wind analysis of the chimney shall be carried out as specified in IS 4998. The effect of openings..... less than 500mm. The minimum vertical reinforcement..... Reinforcement shall be 50mm. Vertical construction joints shall not be used in wind shield. All the openings in wind shield shall be designed as permanent openings. There Shall not be any reverse.....such slope/profile change level.
18.	SEC- VI PART B	IV-D CIVIL WORKS	12 of 66	3.14.04	For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations.	The base material for flue liner shall be mild steel, the thickness of the base metal shall be determined from structural considerations.
19.	SEC- VI PART B	IV-D CIVIL WORKS	13 OF 66	3.14.08	Thermal insulation (Applicable, in case of Titanium / C-276 Flue Liner	Thermal insulation (Applicable, if required as per design)
20.	SEC- VI PART B	IV-D CIVIL WORKS	14 OF 67	3.15.00	Limestone Grinding System building This shall be framed building with R. C. C. roof and floor.	Limestone Grinding System building/Ball Mill building This shall be steel framed building with R. C. C. roof and floor.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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21.	SEC- VI PART B	IV-D CIVIL WORKS	15 OF 67	3.16.00	Gypsum Dewatering Building This shall be framed building with R. C. C. roof and floor.	Gypsum Dewatering Building This shall be steel framed building with R. C. C. roof and floor
22.	SEC- VI PART B	IV-D CIVIL WORKS	20 OF 67	6.08.00	Access to roof of Gypsum dewatering building, GFD Control room Building, MCC building. Ball mill building shall be through staircases.	Access to roofs of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through staircase. For steel staircases, stringers shall be of rolled steel channel (minimum ISMC 250).
23.	SEC- VI PART B	IV-D CIVIL WORKS	40 OF 67	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 manufacture	Wherever specified ceramic tiles of size 600 x300 mm 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 mm thickness and of reputed manufacturer.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
24.	SEC- VI PART B	IV-D CIVIL WORKS	40 of 66	29.02.00	Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7mm 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.	Floors of toilets, pantries / kitchen shall be finished with ceramic tiles 600 mm x 300 mm 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 9.0 mm thk).

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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25.	SEC- VI PART B	IV-D CIVIL WORKS	44 OF 66	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) aluminum frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminum frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-I) with pressed steel door frame. Control room shall have Aluminum glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.	Unless specified all doors, of air conditioned areas, entrance door of air lock lobby of all buildings shall have electro colour coated (anodised) aluminum frame work with 8 mm thick toughened glass glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-I) with pressed steel door frame. Control room shall have Aluminum glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.
26.	SEC- VI PART B	IV-D CIVIL WORKS	45 of 66	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.	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 generally be as per IS 3614 (Part 2).

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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27.	SEC- VI PART B	IV-D CIVIL WORKS	45 of 66	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 thick 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.	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thick 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. Composite double glazing shall be 24mm thick consisting of 6mm thick clear float glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermetically sealed by beading of anodized aluminum with outer edge sealed with silicon sealant. Outer glass of 6mm thickness shall have following technical characteristics: Solar factor 25% or less, Maximum U-value 3.3 W/ SQMK, VLT min 30%: Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25-0.28).

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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28.	SEC- VI PART B	IV-D CIVIL WORKS	47 OF 66	30.08.00	(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.	(d) All air conditioned areas / common corridors shall be provided with false ceiling constructed from Aluminum false ceiling of 600 mm x 600 mm tile of 0.6 mm thick (minimum) with perforation of 2.5 mm dia in combination with built in nonwoven tissue for providing good acoustic properties having coil coating of thickness 25micron (minimum)and installed with T-Grid (of profile 24 mm) in same or contrasting colours or with 6 mm recess joints. Aluminum false ceiling shall be of Luxalon, Durlam or equivalent. 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.
29.	Part-E	TENDER DRAWING			1240-999-POC-F-001 REV 08	1240-999-POC-F-001 REV 09 (Refer Annexure-RIH-GLP-Annexure-A5)
30.	SEC- VI PART A	III-D CIVIL WORKS	1 OF 3	ADD NEW CLAUSE 1.06.00		An area of minimum 10 m width all around the facility buildings and tank foundations shall be paved. Further, wherever multiple FGD facilities are located in a cluster in the areas proposed for FGD (refer GLP), the entire extent of the cluster shall be provided with area paving maintaining minimum 10m width around the facility buildings. Paving shall be extended upto nearest road for easy access to FGD facilities.
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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
31.	SEC- VI PART A	III-D CIVIL WORKS	1 OF 3	ADD NEW CLAUSE 1.07.00		Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be of 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.
32.	SEC- VI PART B	IV-D CIVIL WORKS	3 OF 67	3.01.00	However, 5m wide paving shall also be provided around machinery hatches and Truck hopper.	However, 10m wide paving shall also be provided around machinery hatches and Truck hopper.
33.	SEC- VI PART B	IV-D CIVIL WORKS	22 OF 67	7.00.00	An area of minimum 7.5m width all around the tank foundations and other facility buildings shall be paved.	An area of minimum 10 m width all around the tank foundations and other facility buildings shall be paved.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
34.	VI	A/	6 OF12	3.02.00	One number of covered storage shed for gypsum. The minimum size of storage shed is indicated in the flow diagram to store gypsum equivalent to gypsum generation of minimum 7 days at Design point (Generation of all units to be Considered). Alternatively, Gypsum can be stored in silos like Euro silo or equivalent (minimum 2 Nos. with 7 days storage each OR one No. with 7 days storage along with one bypass arrangement and storage shed for minimum 4 days for gypsum storage. The storage shed shall have facility to transfer gypsum to trucks	One number of covered storage shed for gypsum. The minimum size of storage shed should be equivalent to gypsum generation of minimum 7 days at Design point (Generation of all units to be Considered). Alternatively, Gypsum can be stored in silos like Euro silo or equivalent but not in the conventional storage silos. Number of gypsum storage silo should be minimum two (2) Nos. (with 7 days storage capacity of each silo)or one (1) No. with 7 days storage along with one bypass arrangement and storage shed for minimum 4 days for gypsum storage. The storage shed/silo shall have facility to transfer gypsum to trucks and facilitate loading.
35.	VI /A	III A-5	10 OF12	4.11.00	Belting and Pulley for 1200 TPH	First para of clause, for belting and pulley for 1200 TPH conveying rate, is not applicable for FGD system of LOT-IV projects. However, second para of clause pertain to belting and pulleys for 150 TPH rated conveying capacity for LHP/GHP shall be applicable as stipulated in original specification. In line of above, belt width 1200 mm corresponding to 1200TPH conveying rate also deleted from clause 4.1.1 from section-VI, Part-B, Subsection-I-M-6.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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36.	VI /A	III A-5	12 OF 12	4.18.00	Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways) for 1200 mm Belt Width. Minimum clear cross section of chute: 900 mm X 600 mm (inside both ways) for 800 mm Belt Width	Minimum clear cross section of chute: 900 mm X 600 mm (inside both ways) for 800 mm Belt Width
37.	VI	A/III A-5 FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	24 of 26	5.00.00(a)	Power consumption for all the equipment's including auxiliaries with single stream operation lime stone handling, crushing and gypsum handling plant at its guaranteed flow path capacity in T/Hr Loading factor to be considered as 0.25 for lime stone handling and crushing plant equipment and 1 for Gypsum handling plant. Truck Tippler with Box feeder/Bulk material receiving unit/ /Surface Feeder. Paddle Feeder/Apron Feeder. Vibrating feeders and vibrating screens. Limestone Crushers. Belt Conveyors and Belt Feeders Bucket Elevators Reversible belt feeder/Plough feeder Travelling tripper Any other equipment not included under exclusion Note: Total o P Power consumption for all the equipment including auxiliaries with single stream operation at its guaranteed flow path capacity except: Lighting, Hoist, Lime Sampling unit, Sump Pumps, Elevators, DS,DE,SW System and Potable water system.	Power consumption for all the equipment's including auxiliaries with single stream operation of lime stone handling, crushing and gypsum handling plant at its guaranteed flow path capacity in T/Hr shall be considered . Loading factor for to be considered as 0.25 for lime stone handling and crushing plant equipment and 1 for Gypsum handling plant. For APC following equipment shall be considered in general for material handling system: Truck Tippler with Box feeder/Bulk material receiving unit/ /Surface Feeder, Paddle Feeder/Apron Feeder (as applicable), Vibrating feeders including Vibrating screen feeders, Limestone Crushers, Belt Conveyors and Belt Feeders, Bucket Elevators, Reversible belt feeder/Plough feeder, Travelling tripper, Any other equipment not included under exclusion. Following equipment shall be under exclusion for purpose of APC: Lighting, Hoist, Lime Sampling unit, Sump Pumps, Elevators, DS, DE, SW System and Potable water system.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
38.	VI /A	III A-5	4 of 12	2.1.20(a)		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.
39.	VI	B	29 of 74	Data sheet of belt conveyors: 2.2.3(C)		Bearing life shall be as per CEMA or equivalent standard, subjected to minimum bearing life L10 of 30000 Hrs.
40.	VI	B	30 of 74	Data sheet of Pulleys 2.6.5(5)		Bearing life shall be as per International / Indian Proven standard based on 1000000 cycle of calculated fatigue life.
41.	VI	B	58 of 74	Data sheet of lime stone crushers(1.8.0)		Bearing life shall be standard in references as per technical specifications subjected to minimum bearing life B10 of 40000 Hrs.
42.	VI	B	25 of 74	4.18.00	The Box Feeder should be a robust, proven, above the ground for unloading from trucks/self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder.	The Box Feeder should be a robust, proven, above the ground for unloading from trucks/self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder. Maximum angle of outgoing feeder from BRU to be 20 deg. HARDOX-500 Liner of suitable thickness (min-6mm) to be provided in entire surface come under feeding and abrasion zone of BRU.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
43.	VI/B	Subsec- tion-I-M-6	5 of 74	4.1.6	I. Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50 deg Cent. Ambient. Single LT drive motors shall be used for conveyor drive ratings up to 160 KW. For conveyor drive rating beyond 160 KW, single HT drive shall be used for conveyors. II. For conveyors of belt conveyor systems *120% of actual power at drive motor output shaft at specified Design capacity.	A.Rating of all drive motors of conveyors shall not be less than 110% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50 deg Cent. Ambient. Single LT drive motors shall be used for conveyor drive ratings up to 160 KW. For conveyor drive rating beyond 160 KW, single HT drive shall be used for conveyors. B. For conveyors of belt conveyor systems *110% of actual power at drive motor output shaft at specified design capacity.
			38 of 74	1.1.0(a)		
44.	VI /A	III A-5	2 OF 12	2.01.04(a)		One to two feeding (criss cross) facility to be provide at lime stone crusher house for feeding the each line crusher through both conveyor stream.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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45.	VI/B	II-E12	1 OF 21	1.01.00	i) Rating As per system requirement/SLD/Sub section B-04 vii) Tap Changer As per system requirement/ Sub section B-0/SLD viii) Impedance: At 75°C a) Principal Tap b) Other Taps :As per system requirement/Sub section B-0, B-04/SLD x) Insulation level As per chapter B-0, Part-B xi) Earthing (Copper Flat) As per system requirement/ Sub section B-0/SLD xii) Termination, SC withstand time & Fault Level: As per system requirement/ Sub section B-0/SLD	i) Rating As per system requirement/SLD vii) Tap Changer As per system SLD/ OCTC: +/-5% in steps of 2.5% viii) Impedance: At 75°C a) Principal Tap b) Other Taps :As per system requirement/SLD x) Insulation level As per chapter II-E1, Part-B xi) Earthing (Copper Flat) As per system requirement/ Sub section II-E1/SLD xii) Termination, SC withstand time & Fault Level: As per system requirement/ Sub section II-E12/SLD

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
46.	VI/B	II-E1	6 OF 8	2.08.00	Diesel Generator Set Diesel Generating set(s) shall be provided as per system requirement for safe shut down of the FGD system/plant under emergency conditions and in case of total power failure. DG set(s) shall be capable of meeting 100 % of essential load requirements of FGD System including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop.	Diesel Generator Set Diesel Generating set(s) shall be provided as per system requirement for safe shut down of the FGD system/plant under emergency conditions and in case of total power failure. The DG set shall be capable of starting largest size of emergency 415 V drive (motor) having starting KVA/rated KW ratio of 8 (higher if starting current is more than 8) and starting power factor of 0.2 with terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating.

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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47.	VI/A	IIIB	9 OF 13	1.14.00	CONSTRUCTION POWER To meet the construction power requirement of the complete FGD and associated, the Employer shall provide Two Number 415V feeders in LT switchgears in each stage, power drawal limited to 400KVA from each feeder. In case total construction power requirement is more than 800kVA, Contractor may use one of the Owner's existing HT feeders proposed to be used for FGD, the modification of which is in scope of Contractor as per Tender SLD. 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 for type of connection(HT/LT). Supply, erection, testing and commissioning.....in labor and staff colony.	CONSTRUCTION POWER To meet the construction power requirement of the complete FGD and associated systems , the Employer shall provide Two Number 415V feeders in LT switchgears in each stage, power drawal limited to 400KVA or as permitted by respective DISCOM, whichever is lower, from each feeder. In case total construction power requirement is more than that specified above, Contractor may use one of the Owner's existing HT feeders proposed to be used for FGD, the modification of which is in scope of Contractor as per Tender SLD. 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 for type of connection(HT/LT as applicable). Complete construction power arrangement along with power drawl limits shall comply with respective DISCOM service rules. Supply, erection, testing and commissioning.....in labor and staff colony.
48.	VI/E				SLD for Rihand stage-I 0011-109(4)-POE-J-001/C rev B	SLD for Rihand stage-I 0011-109(4)-POE-J-001/C rev C (Refer RIH SLD REV C)
49.	VI/E				SLD for Kahalgaon stage-I & II 0011-109(4)-POE-J-001/C rev B	SLD for Kahalgaon stage-I & II 0011-109(4)-POE-J-001/C rev C (Refer KAHAL SLD REV C)
50.	VI/E				SLD for Singrauli stage-I & II 0011-109(4)-POE-J-001/C rev B	SLD for Singrauli stage-I & II 0011-109(4)-POE-J-001/C rev C (Refer SING SLD REV C)
FGD SYSTEM PACKAGE LOT-4 PROJECTS					AMENDMENT NO. CS-0011-109(4)-9-AMDT-TECH-01 BID DOCUMENT NO. CS-0011-109(4)-9	Page 19 of 25

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S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS								
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51.	VI/A	IIIB	9 OF 13	1.17.00	<u>FGUTPP stage-I, II and III</u> 8) Added <u>Rihand STPP Stage-I</u> 2) Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. One nos. 33kV feeders shall be provided from this switchgear for feeding of 33/11.5kV miscellaneous service transformer of ratings as indicated in relevant tender SLD. This transformers shall be in scope of bidder and shall be used for feeding of employers existing 11kV miscellaneous/colony switchgear. 5) Added	<u>FGUTPP stage-I, II and III</u> 8) Bidder shall provide the below mentioned additional feeders for owners use, as indicated in relevant SLD, in 33 KV Tie Switchgear. Cable Laying from this additional feeder is excluded from Bidders scope. <table><tr><th>FEED-ER</th><th>RATING</th><th>QUANTITY</th></tr><tr><td rowspan="2">OWN-ERS USE</td><td>15MVA</td><td>1</td></tr><tr><td>10 MW</td><td>2</td></tr></table> <u>Rihand STPP Stage-I</u> 1) Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. Two nos. 33kV feeders shall be provided in this switchgear for feeding of 2 Nos. 33/11.5kV miscellaneous service transformer of ratings as indicated in relevant tender SLD (for employers use). Supply, erection testing commissioning including associated civil works for these transformers shall be in scope of bidder and shall be used for feeding of employers existing 11kV miscellaneous/colony switchgear. 5) Bidder shall provide the below mentioned additional feeder for owners use, as	FEED-ER	RATING	QUANTITY	OWN-ERS USE	15MVA	1	10 MW	2
FEED-ER	RATING	QUANTITY												
OWN-ERS USE	15MVA	1												
	10 MW	2												

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52.						indicated in relevant SLD, in the 11 KV Tie Switch-gear. Cable Laying from this additional feeders is excluded from Bidders scope. <table><tr><td>FEEDER</td><td>RATING</td></tr><tr><td>OWNERS USE</td><td>2000 KVA</td></tr></table>	FEEDER	RATING	OWNERS USE	2000 KVA
FEEDER	RATING									
OWNERS USE	2000 KVA									
53.	VI/B	II-E1	3 OF 8	2.01.00	Transformers All the transformers shall be sized based on the maximum load expected to be fed by them under most onerous conditions or as per the rating indicated in the Electrical Single Line Diagram. All transformers except 220kV class and 132kV class FDG Tie transformers are classified as Auxiliary transformers. FGD Tie transformers (if applicable) shall have ratings as specified in the tender SLD of relevant project. All Auxiliary transformers (unless their ratings have been indicated in Single line Diagram or for which sizing criteria has been indicated in the specification), shall be sized so as to have 10% margin at design ambient conditions after considering final load requirements, including owner's load (if applicable), at peak load conditions and the No Load Voltage Correction Factor. Transformer size = The calculated size X no load voltage correction factor (34.5/33, 11.5/11, 3.45/3.3, 6.9/6.6, 0.433/0.415). No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers.	Transformers All the transformers shall be sized based on the maximum load expected to be fed by them under most onerous conditions or as per the rating indicated in the Electrical Single Line Diagram. FGD Tie transformers (220kV class and 132kV class as applicable) & Transformer's for Owner's use shall have ratings as specified in the tender SLD of relevant project. All transformers (unless their ratings have been indicated in Single line Diagram or for which sizing criteria has been indicated in the specification), shall be sized so as to have 10% margin at design ambient conditions after considering final load requirements, including owner's load (if applicable), at peak load conditions and the No Load Voltage Correction Factor. Transformer size = The calculated size X no load voltage correction factor (34.5/33, 11.5/11, 3.45/3.3, 6.9/6.6, 0.433/0.415). No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers.				
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54.	VI/B	II – E-19	14 of 15	28.04.00	The following type test reports shall be submitted for VFD Panels' 1) VFD panels (For LV VFD)	The following type test reports shall be submitted for VFD Panels' 1) VFD panels (For LV VFD used with load >= 50 KW)
55.	VI/B	II – E-19	7 of 15	12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.	Type: Outdoor Mineral oil filled ONAN type or Indoor air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.
56.	VI/B	II – E-19	10 of 15	20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame.	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame. However, contractor's proven practice with respect to use of insulated bearing in VFD driven motor may be accepted subject to Employer's approval.
57.	VI/B	II – E-19	7 of 15	12.05.00	Winding conductor: Shall be electrolytic grade copper. Windings shall be of class F insulation.	Winding conductor: Shall be electrolytic grade copper. Windings shall be of class F insulation or better.

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	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.																																	
58.	VI/A	VI	16 OF 25	4.01.00	ADDED	iv) Transformer losses The Contractor shall guarantee that total losses of following FGD Tie transformers & transformers for Owner's use supplied under this contract shall not exceed the values indicated in the table below: <table><tr><th>S N o .</th><th>Pro- ject</th><th>Rating (MVA)</th><th>Volt- age ratio (kV)</th><th>Total Losses at 75°C : No load loss + Load Loss (@100%) + Aux losses (k W)</th></tr><tr><td rowspan="2">1</td><td rowspan="2">Ri- hand</td><td>50 MVA</td><td>132/34 .5</td><td>208</td></tr><tr><td>12.5 MVA</td><td>33/11. 5</td><td>80</td></tr><tr><td rowspan="2">2</td><td rowspan="2">Singr auli</td><td>80 MVA</td><td>132/34 .5</td><td>294</td></tr><tr><td>12.5 MVA</td><td>33/11. 5</td><td>80</td></tr><tr><td>3</td><td>Un- cha- har</td><td>50 MVA</td><td>220/34 .5</td><td>218</td></tr><tr><td>4</td><td>Kahal gaon</td><td>80 MVA</td><td>132/34 .5</td><td>294</td></tr></table> For fulfilment of guarantee, the maximum losses measured during factory tests shall be considered. The rate of liquidated damages for shortfall in performance shall be as specified for Auxiliary power consumption in Clause 3.00.00 Sub-section-V, Part-A of Section-VI as applicable for respective project.	S N o .	Pro- ject	Rating (MVA)	Volt- age ratio (kV)	Total Losses at 75°C : No load loss + Load Loss (@100%) + Aux losses (k W)	1	Ri- hand	50 MVA	132/34 .5	208	12.5 MVA	33/11. 5	80	2	Singr auli	80 MVA	132/34 .5	294	12.5 MVA	33/11. 5	80	3	Un- cha- har	50 MVA	220/34 .5	218	4	Kahal gaon	80 MVA	132/34 .5	294
S N o .	Pro- ject	Rating (MVA)	Volt- age ratio (kV)	Total Losses at 75°C : No load loss + Load Loss (@100%) + Aux losses (k W)																																	
1	Ri- hand	50 MVA	132/34 .5	208																																	
		12.5 MVA	33/11. 5	80																																	
2	Singr auli	80 MVA	132/34 .5	294																																	
		12.5 MVA	33/11. 5	80																																	
3	Un- cha- har	50 MVA	220/34 .5	218																																	
4	Kahal gaon	80 MVA	132/34 .5	294																																	

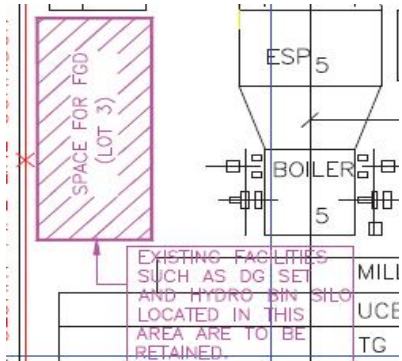
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59.	VI/A	VI	21 OF 25	5.00.00	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT The unit auxiliary power consumption shall be calculated using the following relationship. $P_{an} = P_{un} + T_{Lu}$ P_{an} = Guaranteed Auxiliary Power Consumption for unit # n (Where "n" is the unit number e.g. 1, 2, ...) P_{un} = Power consumed by the auxiliaries of the unit under test T_{Lu} = Proportional Losses of transformers for one Unit/Block T_L = Losses of all the transformers supplied by bidder based on works test Reports T_{Lu} shall be calculated as below: $T_{Lu} = (T_L / \text{Total MW capacity under the present contract}) \times (\text{capacity in MW for FGD (unit/block) under test})$ While guaranteeing the auxiliary power consumption..... (Heater and blower, as applicable) divided by total nos. of units in respective project.	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT The unit auxiliary power consumption shall be calculated using the following relationship. $P_{an} = P_{un} + T_{Lu}$ P_{an} = Guaranteed 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 T_{Lu} = Proportional Losses of transformers for one Unit/Block T_L = Losses of all the transformers supplied by bidder based on works test Reports (excluding FGD Tie transformers(220 kV & 132kV class) & transformers for Owner's use listed in Clause 4.01.00 iv) as applicable in respective project) T_{Lu} shall be calculated as below: $T_{Lu} = (T_L / \text{Total MW capacity under the present contract}) \times (\text{capacity in MW for FGD (unit/block) under test})$ While guaranteeing the auxiliary power consumption..... (Heater and blower, as applicable) divided by total nos. of units in respective project.

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60.	VI/A	VI	23 OF 25	5.00.00	NOTE: 3. 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.	NOTE: 3. Transformer losses (TL) shall be considered as per following (as applicable)- FGD HT/Aux/LT Outdoor/ LT Indoor Transformer: 100 % No load loss and 25 % of Copper Losses.
61.	VI/A	III-A4	1 to 10		Equipment cooling water system scope	Enclosed as Annexure- WS-A
62.	VI/A	IV	1 & 2 of 3	1.03.00	Equipment cooling water Terminal points and exclusion	Enclosed as Annexure- WS-B
63.	VI/B	I-M 5	1 to 15		Equipment cooling water system	Enclosed as Annexure- WS-C
64.	VI/E		8 of 54		P & ID Diagram for ECW system for FGD system package Drg No- 0011-109(4)-POM-A-004 ,Rev-A	P & ID Diagram for ECW system for FGD system package Drg No- 0011-109(4)-POM-A-004 ,Rev-B (Refer Appendix - WS-1)
65.	VI/A	SUB- SECTION-III-A1 (FGD)			VI/E, Singrauli Tender GLP 	New clause added : 24.00.07 For installing the New Wet stack in the identified location as indicated, in case bidder require to shift existing facility like MRS Silo, then MRS Silo along with associated piping etc can be shifted by the bidder at suitable location in the marked area for FGD facilities / at mutually agreed location.

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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00 1.01.00 1.01.01	EQUIPMENT COOLING WATER SYSTEM FOR FGUTPP ST-I (2X210MW), -II (2X210MW) AND -III (1 X210 MW) SCOPE Equipment Cooling Water (ECW) System The Bidder shall provide common Equipment Cooling water system (Primary & Secondary) for stage-I, II & III 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. ECW for FGUTPP ST-I (2X210MW), FGUTPP ST-II (2X210MW) AND ST- III (1 X210 MW) FGD SYSTEM (a) Cold secondary water shall be pumped from stage-II & III CW OAC (CW Channel) nearest to FGD area through 5 x 33.3% (3 working+2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc to PHEs with auto priming system for FGD Auxiliary (Secondary) Cooling water pump . (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) Clarified water for Gypsum washing and make up water line for AC & Ventilation System shall be tapped and pumped from the clarified water tank of Stage-I through 3 x100% (1 working+2 standby) capacity FGD clarified water pumps along with drives and necessary pipe line, valves etc . (d) 2 x100% capacity self-cleaning strainers for cold secondary water. (e) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. (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 and piping for emergency makeup to ECW tank from condensate transfer pump. (j) All Misc. 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. (k) Any other equipment not covered above but required to complete the system.			
	LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 1 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
2.00.00 2.01.00 2.01.01	EQUIPMENT COOLING WATER SYSTEM FOR KAHALGAON STPP ST-I (4X210MW) -II (3 X500 MW) SCOPE Equipment Cooling Water System The Bidder shall provide separate Equipment Cooling water system (Primary & Secondary) for stage- I & II 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. However, Clarified water for Gypsum washing and make up water line for AC & Ventilation System shall be common for stage- I & II FGD units. Clarified water shall be tapped and pumped from the AC cooling water tank of Stage-I through 3 x100% capacity (1 working+2 standby) FGD clarified water pumps along with drives and necessary pipe line, valves etc to FGD area. ECW for KAHALGAON STPP ST-I (4X210MW) FGD SYSTEM (a) Cold secondary water shall be pumped from stage-I CW OAC (CW Channel) nearest to FGD area through 4 x 50 % (2 working+2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc. to PHEs with auto priming system for FGD Auxiliary (Secondary) Cooling water pump. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) 2x100% capacity self-cleaning strainers for cold secondary water. (d) 3 x 50 % (2 working + 1 standby) capacity of plate type heat exchangers. (e) 3 x 50 % (2 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 and piping for emergency makeup to ECW tank from condensate transfer pump (i) All Misc. 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. (j) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 2 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
2.01.02	ECW for KAHALGAON STPP ST-II (3X500 MW) FGD SYSTEM (a) Cold secondary water shall be tapped from the existing CW blow down header of stage- II available nearest to the FGD area and to be pumped to PHEs through 5 x 33.3% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 4 x 33.3% (3 working + 1 standby) capacity of plate type heat exchangers. (e) 4 x 33.3% (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 and piping for emergency makeup to ECW tank from condensate transfer pump (i) All Misc. 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. (j) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM PAGE 3 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
3.00.00 3.01.00 3.01.01 3.01.02	EQUIPMENT COOLING WATER SYSTEM FOR FARAKKA STPP ST-I (3X200MW),-II (2X500MW) AND -III (1X500) SCOPE Equipment Cooling Water System The Bidder shall provide separate Equipment Cooling water system (Primary & Secondary) for stages I ,II and III 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. ECW for FARAKKA STPP ST-I (3X200MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of FARAKKA STPP ST-I and pumped to PHEs through 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc for FGD Process water , Gypsum wash water and make up water for AC & Ventilation System. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system. (c) 2x100% capacity self-cleaning strainers on the secondary side. (d) 2 x 100 % (1 working + 1 standby) capacity of plate type heat exchangers. (e) 2 x 100 % (1 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 and piping for emergency makeup to ECW tank from condensate transfer pump. (i) All Misc. 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. (j) Any other equipment not covered above but required to complete the system. ECW for FARAKKA STPP ST-II (2X500MW) FGD SYSTEM (a) Cold water shall be tapped from existing service water tank of FARAKKA STPP ST-II and pumped to PHEs through 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc for FGD Process water , Gypsum wash water and make up water for AC & Ventilation System. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system.			
	LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 4 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
3.01.03	(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) 3 x 50 % (2 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 and piping for emergency makeup to ECW tank from condensate transfer pump. (i) All Misc. 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. (j) Any other equipment not covered above but required to complete the system.			
	ECW for FARAKKA STPP ST-III (1X500MW) FGD SYSTEM (a) Cold secondary water shall be tapped from the existing CW blow down header of stage- III available nearest to the FGD area and to be pumped to PHEs through FGD Auxiliary (Secondary) Cooling water pumps. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (c) One header shall be tapped from existing HVAC header to FGD area for Gypsum washing and Make up water line for Ac & Ventilation system. (d) 2x100% capacity self-cleaning strainers on the secondary side. (e) 2 x 100 % (1 working + 1 standby) capacity of plate type heat exchangers. (f) 3 x 100% (1 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives and necessary pipe line, valves etc for pumping of water from Cold secondary water header to discharging into the FGD system as process water. (g) 2 x 100 % (1 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives and necessary pipe line, valves etc. (h) One Overhead DM water tank (ECW O/H tank). (i) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (j) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (k) All Misc. 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. (l) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 5 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
EQUIPMENT COOLING WATER SYSTEM FOR SINGRAULI STPP ST-I (5X200MW) - & ST-II (2 X500 MW)	SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system (Primary & Secondary) for stage-I & II 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. ECW for SINGRAULI STPP ST-I (5X200MW) AND SINGRAULI STPP ST-II (2X500MW) FGD SYSTEM (a) Cold secondary water shall be tapped from existing Clarified water tank of CCF- 3 & 4 and pumped through 6 x 25% (4 working+2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves etc. to PHEs for FGD Process water , Gypsum wash water and make up water for AC & Ventilation System. (b) Hot secondary water pipe from the PHE's, discharging into the FGD system (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. (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 and piping for emergency makeup to ECW tank from condensate transfer pump. (h) All Misc. 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. (i) Any other equipment not covered above but required to complete the system.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 6 OF 7

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
5.00.00 5.01.00	EQUIPMENT COOLING WATER SYSTEM FOR RIHAND STPP-I (2 X500 MW) SCOPE Equipment Cooling Water System The Bidder shall provide common Equipment Cooling water system for all the units of stage-I 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) Cold secondary water shall be tapped from the existing CW blow down header of stage- I available nearest to the FGD area and to be pumped to PHEs through 4 x 50 % (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps along with drives and necessary pipe line, valves for FGD process water. (b) Clarified water for Gypsum washing and make up water line for AC & Ventilation System shall be pumped from proposed FGD clarified water tank at STP area through 1 x100% (1 working+2 standby) capacity FGD clarified water pumps along with drives and necessary pipe line, valves etc. (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water (d) 2x100% capacity self-cleaning strainers on the secondary side. (e) 3 x 50 % (2 working + 1 standby) capacity of plate type heat exchangers. (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) One FGD Clarified water tank. (i) One emergency make up pipe line from Stage I clarified water header (Nearest to FGD area) to proposed FGD clarified water tank for Gypsum wash & HVAC system along with necessary pipe line, valves, etc. (j) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc. (k) Piping for normal makeup to ECW tank from existing DM water transfer pump and piping for emergency makeup to ECW tank from condensate transfer pump. (l) All Misc. 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. (m) Any other equipment not covered above but required to complete the system.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC NO.: CS-0011-109(4)-9	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	PAGE 7 OF 7

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS						
1.03.00	Equipment Cooling Water						
	SI No	Project / Stage	Auxiliary (Secondary) water	Clarified Water	Normal make up to ECW tank	Emergency make up to ECW tank	
	1	FGUTPP- I (2 X 210 MW)	Water shall be pumped from suitable location of stage-II & III CW OAC (CW Channel) available nearest to the FGD area.	Shall be pumped from clarified water tank of FGUTPP ST-I.	Contractor shall take a tap off suitably from the existing DM normal make up pump discharge) available near C-row for meeting the normal makeup water requirement.	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.	
	2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)					
	3	Farakka-I (3 X 200 MW)	Shall be tap off suitably from clarified water tank of Farakka STPP ST-I.				
	4	Farakka- II (2 X 500 MW)	Shall be tap off suitably from from service water tank of Farakka STPP ST-II.				
	5	Farakka-III (1 X 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Farakka STPP ST-III.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.			
	6	Kahalgaon-I (4x 210 MW)	Water shall be pumped from suitable location of stage-I CW OAC (CW Channel).	Shall be pumped from AC Cooling Water tank of stage-I.			
	7	Kahalgaon-II (3x 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP ST- II.				
	8	Singrauli-I (5 x200 MW)	Shall be suitably pumped from clarified water tank of CCF- 3 & 4.				
	9	Singrauli-II (2 x500 MW)					
	10	Rihand-I (2 X 500 MW)	Shall be tap off suitably from the existing CW blow down header of stage-I available near FGD area.	Shall be pumped from proposed FGD clarified water tank at STP area.			
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS			PAGE 1 OF 2

CLAUSE NO.	TERMINAL POINTS & EXCLUSIONS 	
	Note- (1) Auxiliary (Secondary) water from PHE outlet shall be used as input to process water system. Maximum Auxiliary (Secondary) water quantity available at TP mentioned in ECW system chapter, Part –B of technical specification. (2) Clarified Water shall be used for Gypsum washing and HVAC make up. Maximum Clarified Water quantity available at TP will be 0.018 m3/hr/MW. (3) Maximum quantity of Normal make up water to ECW tank of ECW system will be 2m3/hr. The pressure available at TP will be 4Ksc (gauge) w.r.t FGL (approx.). (4) Maximum quantity of Emergency make up to ECW tank of ECW system will be 2m3/hr. The pressure available at TP will be 4 Ksc (gauge) w.r.t FGL (approx.). For 200 / 210 MW units location of existing header is available in BC-bay and pressure shall be 2Ksc (gauge) w.r.t FGL (approx.). (5) For the projects having common ECW system, tapping for normal make up & emergency make up water of specified quantity shall be taken from any one the stages nearest to FGD area, whereas for the projects having separate ECW system, tapping for normal make up & emergency make up water of specified quantity shall be taken from respective stage. (6) Clarified water tank or Service water tank or AC Cooling water tank are above ground tank and suitable for flooded suction of pump at atmospheric pressure. (7) There will be negative suction for auxiliary (Secondary) water pumps to be installed at CW OAC (CW channel). Bidder has to envisage auto priming system of required capacity for the same. (8) The pressure available at TP will be 1.7 Ksc (gauge) w.r.t FGL (approx.) for CW blowdown header. (9) The pressure available at TP will be 4 Ksc (gauge) w.r.t FGL (approx.) for HVAC header. 1.04.00 Not used 1.05.00 Not used 1.06.00 Not used 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 FGD area.	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(4)-9	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS PAGE 2 OF 2

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	EQUIPMENT COOLING WATER (ECW) SYSTEM 1.00.00 BRIEF DESCRIPTION OF SYSTEM 1.01.00 The Equipment Cooling Water System shall be provided for Flue Gas Desulphurization system Auxiliaries as described. 1.02.00 Cooling water system for Flue Gas Desulphurization system Auxiliaries shall be of closed circuit type with demineralized (DM) water in the primary circuit. The Auxiliary (Secondary) water (to be subsequently used as input to process water system) , Gypsum wash water and make up water for AC & Ventilation system shall be tapped as specified in Terminal points & Exclusion chapter of the technical specification. All materials of construction used in primary and secondary side of the equipment cooling water system should be suitable for the respected water quality. The scheme shall be as per relevant tender drawing listed elsewhere in the specification. The DM cooling water pumps shall be provided as indicated in the relevant tender drawing. 1.03.00 Quality of water (a) Primary circuit - Demineralized (DM) water (b) Secondary circuit - Condenser cooling water/ Clarified water 1.04.00 The pH of DM water in the closed loop shall be continuously monitored and controlled at around 9.5. The control shall be achieved by dosing sodium hydroxide in DM water overhead tank and DM water header. The dosing shall be done manually by operating dosing valve. 2.00.00 SYSTEM DESIGN 2.01.00 The ECW system design for Flue Gas Desulphurization system Auxiliaries shall be as follows: In the primary circuit, Demineralized cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE) for cooling of the FGD system auxiliaries. The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to the individual Flue Gas Desulphurization system Auxiliaries coolers. No booster pumping system shall be provided in the primary system. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit. 2.02.00 The auxiliary (secondary) circulating water system shall be pumped through a set of auxiliary (secondary) cooling water pumps either from CW OAC or CW blow down or clarified water tank or service water tank for different stages of different projects as mentioned in terminal & exclusion chapter and fed through the plate type heat			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 1 OF 17

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	exchangers and the discharge secondary water from PHEs shall be used as input to process water for FGD system. The Gypsum Wash Water and HVAC make up water (Clarified Water) shall be supplied either through clarified water tank or service water tank or tapping from HVAC header or AC cooling water tank or proposed FGD clarified water tank for different stages of different projects, details as mentioned in terminal & exclusion chapter. 2.03.00 For the primary cooling circuit, an overhead tank of minimum (normal) capacity of 5 Cu.M shall be provided by the bidder. Outlet of this tank shall be connected to the closed circuit return header. The normal capacity of the tank shall be at 60% of the tank height to serve. 2.04.00 Frame of each plate type heat exchanger shall have about 25% extra capacity i.e. the frame shall be able to accommodate about 25% extra plates. 2.05.00 Make up to the closed loop primary circuit shall be taken from the DM water transfer pumps located near DM water storage tank and emergency make up from the discharge of condensate transfer pumps. The make-up would be given to overhead storage tank separately. 2.06.00 Required orifices shall be provided in the primary and secondary circuit of Equipment Cooling Water system for balancing of pressure. 2.07.00 Proposed FGD Clarified water tank (for Rihand Stage-I Gypsum wash & HVAC system) of minimum (normal) capacity of 40 Cu.M shall be provided by the bidder. The normal capacity of the tank shall be at 90% of the tank height to serve. The tank shall be provided with construction features same as ECW overhead tank for design standard, design pressure and MOC. Tank shall be equipped with common accessories like Vent line, overflow line, drain line, Manhole, approach Ladder and platform along with necessary valves etc. 3.00.00 CONSTRUCTION FEATURES 3.01.00 Pumps and Heat (PHE) Exchangers 3.01.01 The general design and construction features of various pumps of the Equipment Cooling Water System shall be as per the Annexure titled “GENERAL SPECIFICATION FOR HORIZONTAL PUMPS” enclosed with this sub-section. 3.01.02 Specific features of various pumps and plate type heat exchangers of ECW system shall be as follows :- A) Pumps (ECW System) i) Type : Horizontal Centrifugal type ii) Casing : Axially split type.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 2 OF 17	

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		एन टी पी सी NTPC
	i) Mechanical Seal SiC/TiC ----- j) Base plate ----- MS fabricated - IS:2062 ----- k) Stuffing Box ----- 2.5% Ni Cl to IS 210 GR – FG-260 l) All fasteners Stainless steel Stainless steel B) Plate type Heat Exchangers - Design Parameters (i) Type : Plate type, single pass (ii) Design pressure : Maximum expected pressure to which PHE may be subjected plus 5% additional margin. Maximum expected pressure shall be based on the shut-off head of pumps (either the secondary or primary side whichever is maximum) plus the suction pressure of the pumps. Material of Construction (i) Heat transfer plate : SS-AISI-316 (ii) Compression / Fixed plates : IS:2062 (iii) Movable pressure plate : IS-2062 (iv) Guide rail : IS-2062 with stainless steel cladding (v) Support Beam/Column : IS 2062 (vi) Plate gasket : Nitrile Rubber (vii) Nozzle : Carbon steel (viii) Flanges : Carbon steel (ix) Nozzle flange Gasket : 3 mm wire inserted Red Rubber. (x) Nozzle flange Bolts/ Nuts : SA 193 B7/SA 194 2 H. (xi) Name plate : AISI-316 (xii) Tightening Rods : IS-1367 or equivalent Other Features: (i) Double sealing arrangement should be provided at outer edge and around ports to avoid intermixing of fluids. The inter-space should be vented to atmosphere.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 4 OF 17

CLAUSE NO.		EQUIPMENT COOLING WATER SYSTEM		एनटीपीसी NTPC																			
		(ii) Plate thickness should be adequate to withstand all operating conditions but not less than 0.6 mm. (iii) Frame of exchanger should be designed so that 25% additional plates can be added in future. (iv) Flanges shall be per ANSI B 16.5 for equivalent. (v) Thickness of pressure and frame plates as per ASME sec. VIII Div. I. (vi) Minimum corrosion allowance for heat exchanger parts shall be 1.6 mm. (vii) After pressing all the plates shall be tested by light box/vacuum/air chamber test as per manufacturers' standard practice. (viii) The corrosion allowance for the heat exchanger plate such as pressure parts (support plates), nozzles, sliding channels and frame shall be 1.6mm (minimum).																					
3.02.00		Piping, Valves /Tanks: Construction features of Piping, Valves and tanks shall be as per the sub-section titled "Low Pressure Piping" of this Technical specification.																					
3.03.00		Self-cleaning strainer: (a) To prevent fouling on the secondary cooling waterside of the PHE, self-cleaning type filters, (2 X 100%) shall be provided by the bidder on the secondary cooling water inlet header to the PHE. (b) Body of filter shall conform to IS:210Gr. FG260 or ASTM-A-515 Gr. 75/IS: 2062 and internally painted with epoxy. (c) Strainer element shall be constructed of perforated stainless steel plant linked with stainless steel (SS316) screen for fresh water and SS316L grade SS screen for sea water. (d) The mesh size shall be selected on the basis of average clearance between the plates of the plate heat exchanger.																					
3.04.00		Construction features of ECW overhead tank <table><tr><th>Sl. No.</th><th>Description</th><th>Tech. Particulars</th></tr><tr><td>I.</td><td>Quantity</td><td>: One (1)</td></tr><tr><td>II.</td><td>Capacity</td><td>: 5 Cu.M (Minimum.)</td></tr><tr><td>III.</td><td>Type</td><td>: Horizontal Dished ends</td></tr><tr><td>IV.</td><td>Design Pressure</td><td>: Atmospheric</td></tr><tr><td>V.</td><td>Design Standard</td><td>: ASME Boiler and Pressure Vessel code Section-VIII/IS:2825 (Class 3)</td></tr></table>				Sl. No.	Description	Tech. Particulars	I.	Quantity	: One (1)	II.	Capacity	: 5 Cu.M (Minimum.)	III.	Type	: Horizontal Dished ends	IV.	Design Pressure	: Atmospheric	V.	Design Standard	: ASME Boiler and Pressure Vessel code Section-VIII/IS:2825 (Class 3)
Sl. No.	Description	Tech. Particulars																					
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LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9		SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 5 OF 17																			

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		एनटीपीसी NTPC	
3.05.00	VI.	Material of Construction	: Plates to IS:2062/ ASTM A36.Minimum shell thickness shall be 6mm.	
	VII.	ACCESSORIES		
	(a)	Vent, overflow and drain	: Required (Overflow drain to be taken upto '0' M plant drain)	
	(b)	CO ₂ absorber for vent	: Required	
	(c)	Seal for overflow	: Required	
	(d)	Manhole & approach Ladder/platform/	: Required	
	Construction features of Alkali dosing tank.			
	Quantity per Unit		: One (1)	
	Useful Capacity of Each Tank		: Suitable for the system (Minimum 500 lt)	
	Size (Dia. x Height)		: Adequate	
	Type		: Vertical cylinder, dished bottom	
	Design Pressure		: Atmospheric	
	Design Standard		: ASME Boiler & Pressure vessles Code Section-VIII. Div.I/ IS:2825 (Class-3)	
	Material of Construction		: MS Plates to IS:2062/ ASTM A36. with rubber lining of 4.5 mm thick & Minimum shell thickness shall be 6mm. OR SS plates of minimum thickness of 3 mm .	
	Dissolving Basket		: AISI-316,	
	Agitator		: Propeller type agitator of stainless steel 316SS construction along with drive motor of suitable rating and protection class. (With Slow speed reduction gear unit)	
	Accessories			
(a)	Vent, overflow and Drain	: Required		
(b)	Sample Connection	: Required		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 6 OF 17

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM	
4.00.00 4.01.00 4.02.00	SIZING / DESIGN CRITERIA Pumps a) Flow : Auxiliary (secondary) cooling water pumps; Total secondary water design flow – As per system requirement (Less than or equal to maximum flow available as per Annexure-II). <u>Primary Water pumps.</u> Design flow of all Flue Gas Desulphurization system Auxiliaries coolers. b) Head : As per system requirement +10% margin on friction head. c) Motor rating : Continuous motor rating (at 50 degree C ambient) for all pumps shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. d) No. of Primary side pumps : As indicated in Part A of the specification. e) No. of Secondary water pumps. : As indicated in part A of the specification. f) Re-circulation control Valves, Piping & Pressure break down orifice. : Required g) Additional design requirements : To be referred in the Annexure Sub-section titled "GENERAL SPECIFICATION FOR HORIZONTAL PUMPS" enclosed with this section. Plate Type Heat Exchangers a) Design Secondary water Inlet temperature : Not less than 36 deg. C b) Secondary water outlet : Temperature as achieved subject to the maximum ACW flow indicated. d) Overall fouling factor (minimum) (f) : 0.8×10^{-4} Hr M² deg C/Kcal e) No. of heat exchangers/ unit : As indicated in part A of the specification	
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 7 OF 17

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	f) Overall Heat transfer coefficient [U(o)]: As per manufacturer's design g) Dirty Heat transfer Coefficient [U(d)] : $[1 / (1/U(o) + f)]$ h) Heat Transfer Area (Sqm) : $\frac{\text{Total Heat Load (in Kcal/hr)}}{U(d) \times \text{LMTD}}$ i) Heat transfer area of PHE shall be selected such that each Sq.M of heat transfer plate shall transfer not more than 6500 Kcal/hr.			
5.00.00	INSTRUMENTATION			
5.01.00	All instruments, such as thermowell, temperature element alongwith temperature transmitter, flow element, pressure/DP and temperature gauge/transmitters/sensors/switches, DP switch, pH analyzer, Rotameter etc. alongwith associated devices should meet the requirement as specified in relevant sub-section of this Technical Specification and shall be sufficient to meet all interlock/protection & operation requirement.			
5.02.00	Minimum instrumentation required for the Equipment Cooling water system shall be as per tender P & I Diagram wherever included in the specification.			
6.00.00	CONTROL / OPERATION PHILOSOPHY			
6.02.00	The pump suction valves, re-circulation valves and discharge valves shall be motor actuated type to enable remote operation.			
6.03.00	Pump suction valves shall be provided with required limit switches for interlock & control.			
6.04.00	The pumps shall be designed to operate under discharge valve open and as well as in close condition.			
6.05.00	Wherever more than one sump/tank is provided, Suction header shall be interconnected such a way that any of the sump/tank may be selected from the panel for operation.			
6.06.00	Any of the pump shall be selectable as standby duty. Standby pump shall come into operation on tripping of working pump or inadequate pressure in the discharge header.			
6.07.00	Suction and Discharge valves of pumps shall be interlocked with start/stop of respective pumps.			
6.08.00	Local emergency stop provision for each pump shall be provided.			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 8 OF 17

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			एनटीपीसी NTPC
6.09.00	All the working pumps shall be interlocked with the suction level or suction pressure condition as the case may be. Pumps operation shall be interlocked with the high discharge condition so that the pump may not operate at shut-off pressure.			
6.10.00	Automatic inlet valves at supply line to each of the tank/sump shall be provided so that the valves shall open and close at low-level and very high-level respectively.			
6.11.00	A control valve shall be provided to maintain a constant pressure differential between the main supply and return headers of DM water. The valve will bypass flow to maintain a constant return header pressure to compensate for fluctuations in coolant flow to the process heat exchangers due to modulating control valves on the process coolers or if any cooler goes out of service in DM circuit.			
6.12.00	Alarm to indicate high differential pressure across self-cleaning filter strainers, heat exchangers as the case may be.			
6.13.00	Manually operating globe / regulating valves shall be provided in the water side of each of the cooler outlet for control of flow as specified in respective equipment specification.			
6.14.00	Detailed Interlock & protection logic to be implemented in FGD control system shall be provided by the contractor and the same shall be as finalized during detailed engineering.			
7.00.00	PAINTING			
7.01.00	All the equipments such as pumps, tanks and plate type exchangers of this system shall be protected against external corrosion by providing suitable painting as mentioned below. For painting of valves and piping, relevant section shall be referred to.			
7.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.			
7.03.00	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot-blasting etc as per the agreed procedure.			
7.04.00	For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.			
7.05.00	For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primer of minimum thickness of 50 microns followed up with undercoat of synthetic enamel paint of minimum thickness of 50 microns shall be applied. The top coat shall consist of two coats each of minimum thickness of 50 microns of synthetic enamel paint and thus total thickness shall be minimum 200 microns.			
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CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM 		
7.06.00	Internal surfaces of ECW over tank shall be painted with One coat of unmodified epoxy resin alongwith polyamide hardener and minimum two (2) coats unmodified epoxy resin alongwith Aromatic adduct hardener and total thickness of primer and paint should not be less than 400 microns.		
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 10 OF 17

CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM			
	Annexure-I to ECW system Specification GENERAL SPECIFICATION FOR HORIZONTAL PUMPS (ACW, ECW and CLARIFIED WATER PUMPS) (1) SCOPE This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps. (2) CODES AND STANDARDS The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards. (3) LIST OF APPLICABLE STANDARDS IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water IS : 5120 : Technical requirements of rotodynamic special purpose pumps API : 610 : Centrifugal pumps for general refinery service. IS : 5639 : Pumps Handling Chemicals & corrosion liquids IS : 5659 : Pumps for process water HIS : Hydraulic Institute Standards, USA ASTM-1-165-65: Standards Methods for Liquid Penetration Inspection. In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail. (4) DESIGN REQUIREMENTS (a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	PAGE 11 OF 17

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(5)	the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.			
	(b) The total head capacity curve shall be continuously rising from the operating point towards shut – off without any zone of instability with the highest head at shut-off condition. Shut-off head shall be more than the rated design head by 15 % or more for radial flow pump and 25 % more than the design head for mixed flow/turbine type pumps.			
	(c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.			
	(d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:			
	<u>Speed</u>	<u>Antifriction Bearing</u>	<u>Sleeve Bearing</u>	
	1500 rpm and below	75.0 micron	75.0 micron	
	3000 rpm	50.0 micron	65.0 micron	
	The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.			
	(e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements.			
	(f) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.			
(g) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.				
DESIGN CONSTRUCTION				
(a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.				
(b) Pump Casing				
Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.				
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	Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation. (c) Impeller Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation. (d) Impeller/Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations of pumps as per manufacturer's standard practice. Suitable method of locking the wearing ring shall be used. (e) Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation. (f) Shaft Sleeves Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation. (g) Bearings Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.			
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	The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing. (h) Stuffing Boxes Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection. (i) Mechanical Seals Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped. (j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply. (k) Pump Shaft Motor Shaft Coupling The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.			
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	(l)	Base Plate	A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.	
	(m)	Assembly and Dismantling	Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.	
	(n)	Drive Motor (Prime Mover)	Continuous Motor rating (at 50 0 C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. The KW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).	
	(o)	Auto Prime Unit (As applicable)	Each pump shall be provided with an auto prime unit that will ensure the desired suction lift thus avoiding the requirement of manual priming. The priming unit shall-be capable to prime from a completely dry volute and suction line. The priming unit shall consist of either vacuum pump or compressor with venturi arrangement as per proven practice of the pump manufacturer.	
(6)	Performance Test	The performance tests shall be carried out in two stages (i) After manufacture of pump, at shop (ii) After installation of all the pumps and completion of initial trial operation and test shall be conducted at site.		
	(I)	Performance Test at Shop	After the manufacturing, the pumps shall be subjected to performance test at manufacturer's works which will include establishing the pump performance curve (Head-Capacity, Power-Capacity, Efficiency-Capacity), NPSH, measurement of vibration, noise level, bearing temperature etc., and verifying the guaranteed parameters in the presence of Employer's representative and pump supplier/manufacturer.	
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9		SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM
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CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		
	For carrying out performance test at shop, actual motor and auto prime unit (if required) shall be used. (II) Performance Tests at Site After installation of the pumps, the tests shall be conducted to demonstrate the satisfactory operation of pumps. The parallel operation of the pumps shall be demonstrated/tested. There should be equal load sharing between pumps running in parallel with no abnormal vibrations, sound or hunting of head and flow. Load sharing between any pumps running in parallel should be within 10%. Bidder shall submit the testing procedure of the pumps for Employer's approval. Required calibrated instruments & measurement devices shall be provided by the Contractor.		
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CLAUSE NO.	EQUIPMENT COOLING WATER SYSTEM		एनटीपीसी NTPC																		
	Annexure-II Maximum Auxiliary (Secondary) water available:- <table><tr><td>Sl. No</td><td>Project</td><td>Maximum Qty. of available water for FGD Process requirement (cum/hr)</td></tr><tr><td>1</td><td>FGUTPP STAGE-I,II & III</td><td>265</td></tr><tr><td>2</td><td>KAHALGAON STPP A) ST-I (4X210MW) B)ST-II (3X500MW)</td><td>A) 210 B) 375</td></tr><tr><td>3</td><td>FARAKKA STPP A) ST-I (3X200MW) B)ST-II(2X500MW) C)ST-III(1X500)</td><td>A) 150 B) 250 C) 125</td></tr><tr><td>4</td><td>SINGRAULI STPP -I,& II</td><td>500</td></tr><tr><td>5</td><td>RIHAND STPP-I (2 X500 MW)</td><td>250</td></tr></table> Note- (1) System for different projects shall be designed common or separate (as mentioned) with considering actual requirement of water corresponding to design points mentioned in the equipment cooling water system specification. (2) Total allocated water (Auxiliary (Secondary) water & clarified water for gypsum wash including HVAC make up) quantity shall remain unaltered. However, if additional clarified water is required, the same shall be produced by the bidder from the allocated Auxiliary (Secondary) water quantity by using suitable treatment process to meet the quality as required, without any additional cost to NTPC.			Sl. No	Project	Maximum Qty. of available water for FGD Process requirement (cum/hr)	1	FGUTPP STAGE-I,II & III	265	2	KAHALGAON STPP A) ST-I (4X210MW) B)ST-II (3X500MW)	A) 210 B) 375	3	FARAKKA STPP A) ST-I (3X200MW) B)ST-II(2X500MW) C)ST-III(1X500)	A) 150 B) 250 C) 125	4	SINGRAULI STPP -I,& II	500	5	RIHAND STPP-I (2 X500 MW)	250
Sl. No	Project	Maximum Qty. of available water for FGD Process requirement (cum/hr)																			
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4	SINGRAULI STPP -I,& II	500																			
5	RIHAND STPP-I (2 X500 MW)	250																			
LOT-4 PROJECTS FLUEGAS DESULPHURISATION(FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(4)-9	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM PAGE 17 OF 17																		

TABLE NO. : 179**RESULTS OF CHEMICAL ANALYSIS OF SOIL SAMPLES**

Sl. No.	Bore Hole No.	Sample No.	Depth of below existing ground surface (m)	pH value	Type of test conducted					
					Carbonate (as CO ₃)	Sulphate		Chloride (as CL)	Nitrate (NO ₃)	Organic matter
						(as SO ₃)	(as SO ₄)			
					(%)	(%)	(%)	(%)	(%)	(%)
1	BH-1	UDS-1	2.50 - 2.90	6.4	NIL	0.0124	0.0149	0.0103	0.0050	0.0908
2	BH-5	UDS-2	4.00 - 4.40	6.5	NIL	0.0232	0.0280	0.0370	0.0044	0.0725
3	BH-11	UDS-1	2.50 - 2.90	7.2	NIL	0.0301	0.0363	0.0350	0.0039	0.0852
4	BH-18	UDS-1	1.00 - 1.40	6.5	NIL	0.0257	0.0310	0.0361	0.0037	0.0815
5	BH-25	UDS-2	4.00 - 4.40	6.6	NIL	0.0247	0.0297	0.0175	0.0048	0.0653
6	BH-28	SPT-1	1.00 - 1.45	7.3	NIL	0.0133	0.0160	0.0125	0.0033	0.0725
7	BH-34	SPT-2	5.00 - 5.45	6.7	NIL	0.0203	0.0245	0.0350	0.0019	0.0135
8	BH-39	UDS-2	4.00 - 4.40	7.3	NIL	0.0187	0.0225	0.0325	0.0043	0.0850
9	BH-40	SPT-1	2.50 - 2.90	7.1	NIL	0.0219	0.0264	0.0245	0.0011	0.0276
10	BH-44	UDS-1	1.00 - 1.40	6.4	NIL	0.0237	0.0285	0.0230	0.0018	0.0143
11	BH-56	SPT-1	2.50 - 2.95	6.8	NIL	0.0158	0.0190	0.0240	0.0040	0.0625
12	BH-58	UDS-2	4.00 - 4.40	6.5	NIL	0.0264	0.0318	0.0280	0.0023	0.0510
13	BH-60	SPT-2	5.50 - 5.95	6.9	NIL	0.0150	0.0181	0.0180	0.0030	0.0423
14	BH-63	UDS-2	5.50 - 5.90	6.6	NIL	0.0291	0.0350	0.0120	0.0027	0.0253
15	BH-65	UDS-1	1.00 - 1.40	7.0	NIL	0.0224	0.0270	0.0390	0.0052	0.0333

TABLE NO. : 180

RESULTS OF CHEMICAL ANALYSIS OF WATER SAMPLES

Sl. No.	Bore Hole No.	pH Value	Type of test conducted									
			Carbonate	Sulphate Content		Chloride Content	Nitrate	Organic	Colour	Odour	Turbidity	Specific Conductivity
			(as CO ₃)	(as SO ₃)	(as SO ₄)	(as CL)	(NO ₃)	matter			(NTU)	(μ mhos/cm)
			(%)	(ppm)	(ppm)	(ppm)	(%)	(%)				
1	BH-2	6.9	NIL	37	45	43	0.0040	0.0067	White	No Specific odour	153	160
2	BH-5	7.5	NIL	66	79	157	0.0020	0.0193	White	No Specific odour	356	840
3	BH-9	7.6	NIL	62	75	150	0.0025	0.016	White	No Specific odour	280	720
4	BH-11	7.1	NIL	40	48	50	0.0067	0.0072	White	No Specific odour	323	230
5	BH-18	7.8	NIL	75	90	110	0.0018	0.0141	White	No Specific odour	380	523
6	BH-25	7.3	NIL	43	52	57	0.0065	0.0018	White	No Specific odour	265	850
7	BH-27	7.4	NIL	42	50	123	0.0066	0.0142	White	No Specific odour	429	660
8	BH-35	7.7	NIL	56	67	59	0.0014	0.0245	White	No Specific odour	220	926
9	BH-40	6.9	NIL	44	53	166	0.0053	0.0023	White	No Specific odour	270	366
10	BH-46	6.9	NIL	51	62	64	0.0018	0.0208	White	No Specific odour	410	420
11	BH-52	7.0	NIL	56	68	119	0.0034	0.0080	White	No Specific odour	160	343
12	BH-58	7.2	NIL	71	85	67	0.0057	0.0220	White	No Specific odour	395	180
13	BH-62	7.3	NIL	48	58	137	0.0070	0.0129	White	No Specific odour	175	550
14	BH-65	6.9	NIL	53	64	75	0.0029	0.0193	White	No Specific odour	225	780
15	BH-67	7.5	NIL	66	80	82	0.0031	0.0060	White	No Specific odour	350	235

RESULTS OF ELECTRICAL RESISTIVITY TESTS
GEOTECHNICAL INVESTIGATION FOR FGUTPP, UNCHAHAR STAGE-IV, AT THE LOCATIONS OF
TRACK HOPPER AREA

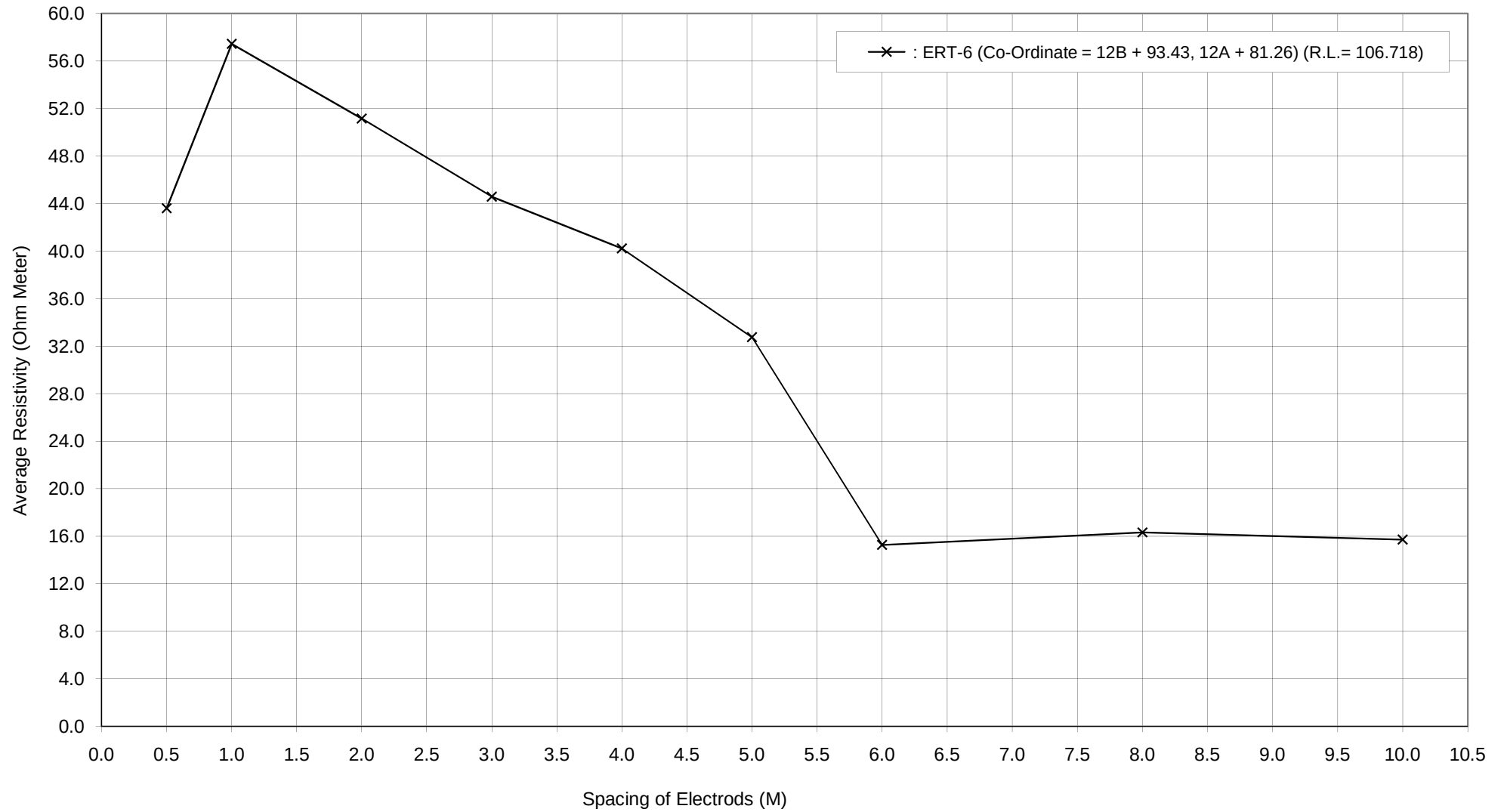


FIG. NO. : 47 SPACING OF ELECTRODES Vs AVERAGE RESISTIVITY CURVES

RESULTS OF ELECTRICAL RESISTIVITY TESTS
GEOTECHNICAL INVESTIGATION FOR FGUTPP, UNCHAHAR STAGE-IV, AT THE LOCATIONS OF
ESP AREA

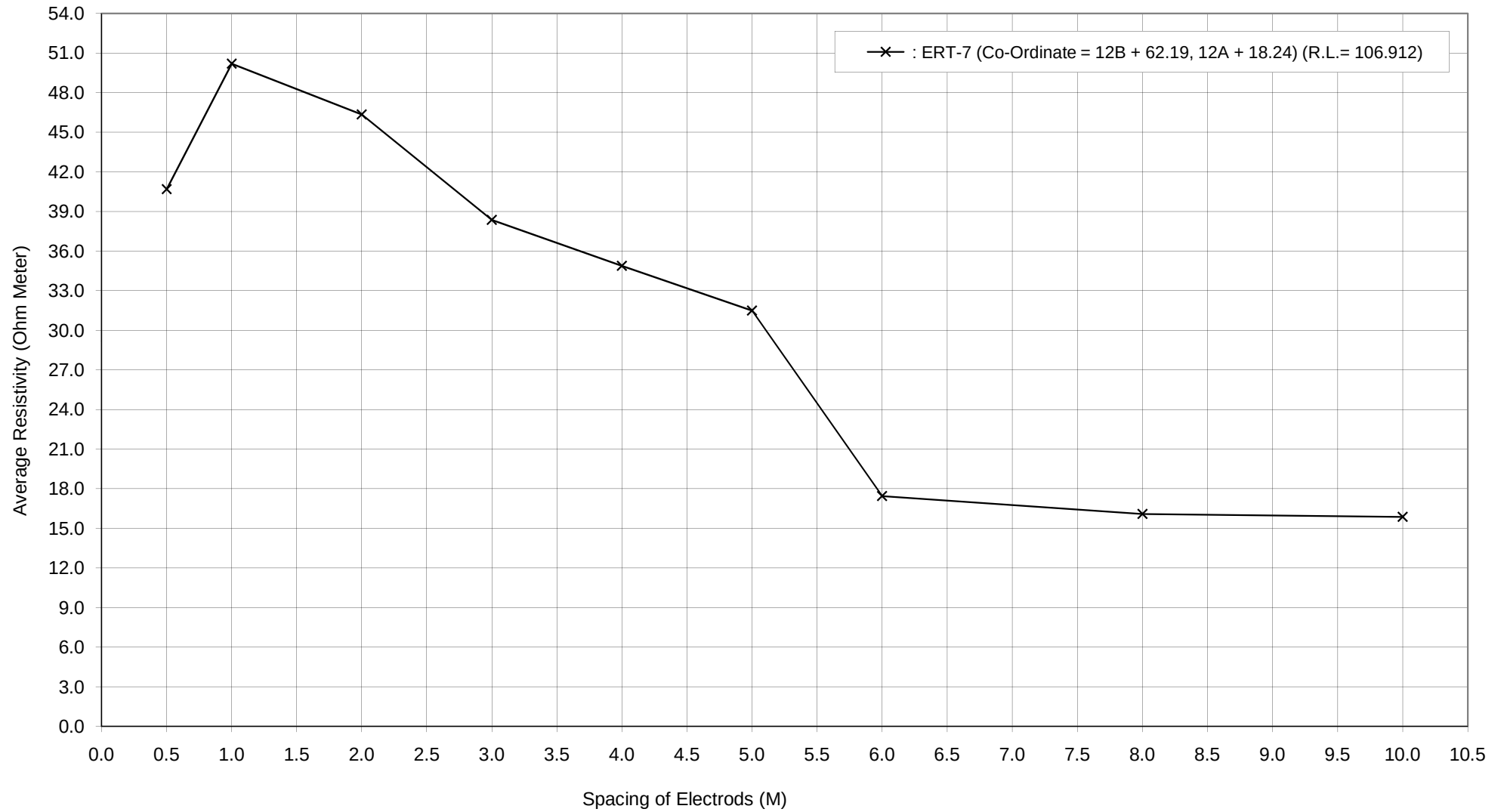


FIG. NO. : 47 SPACING OF ELECTRODES Vs AVERAGE RESISTIVITY CURVES



LABORATORY TEST RESULTS

Project:- Proposed Electrical Control Room of ESP-1, Stage -I, (3 X 200 MW), NTPC, Farakka, Dist.- Murshidabad, W.B.

Sl. No.	BH No.	Sample Ref. No.	DEPTH FROM EGL, m	SOIL DESCRIPTION	NMC (%)	ATTERBERG LIMIT			DENSITY		Specific Gravity	TRI-AXIAL Shear Results		Consolidation Test			Grain Size Distribution			
						Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Bulk Density (M/m ³)	Dry Density (M/m ³)		C-value (Mt/m ²)	ϕ^0	e ₀	C _c	C _u /1+e ₀	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
1	1	U-1/1	2.00	Grey sandy silt, with traces of clay.	20.5	NP	NP	-	1.8	1.53	-	1.60	24 ⁰	-	-	-	0	30	62	8
2	1	U-1/2	5.00	Greyish brown & grey silty clay.	33.5	83	30	53	1.86	1.39	2.71	4.15	0	0.880	0.183	0.097	0	2	56	42
3	1	U-1/3	8.00	Mottled dark bluish grey & yellowish brown silty clay.	31.6	70	27	43	1.85	1.41	2.72	3.49	0	0.851	0.165	0.089	2	4	54	40
4	1	U-1/4	14.50	Dark grey, with brownish patches, silty clay.	32.4	65	25	40	1.84	1.39	2.70	4.30	-	0.909	0.166	0.087	0	1	60	39
5	1	U-1/5	23.50	Dark grey silty clay, with kankar.	23.0	49	27	22	1.98		2.71	15.70	0	0.630	0.114	0.070	0	6	67	27
6	2	S-2/1	1.00	Brownish grey sandy silt, with traces of clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	24	68	8
7	2	U-2/1	4.00	Greyish brown & dark grey silty clay.	37.7	64	26	38	1.87	1.43	2.71	3.50	0	0.941	0.224	0.115	0	0	56	44
8	2	U-2/2	7.00	Mottled dark grey & greyish brown silty clay.	33.5	98	48	50	1.89	1.42	2.70	5.25	0	0.957	0.234	0.120	0	1	56	43
9	2	U-2/3	10.00	Mottled dark bluish grey, with yellowish patches silty clay.	34.2	93	45	48	1.85	1.38	2.71	4.10	0	0.909	0.210	0.110	0	0	56	44
10	2	U-2/4	15.00	Dark bluish grey, with yellowish patches silty clay, mixed with kankar & black moorum.	32.1	86	40	46	1.86	1.36	2.70	4.20	0	0.860	0.124	0.067	0	0	62	38
11	2	SP-2/6	18.00	Dark bluish grey clayey silt/ silty clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	4	76	20
12	2	U-2/5	24.00	Dark grey silty clay, with traces of sand.	22.1	48	26	22	2.03	1.67	2.70	16.40	-	0.590	0.103	0.065	0	10	61	29
13	2	SP-2/8	27.00	Mottled dark grey with yellowish brown silty clay, with traces of sand.	-	49	24	25	-	-		-	-			-	0	6	61	33
14	3	U-3/1	4.50	Mottled brownish grey & grey silty clay, with traces of sand.	32.2	93	45	48	1.84	1.40	2.71	4.05	0	0.863	0.151	0.081	0	2	51	47
15	3	U-3/2	7.50	Brownish grey & grey silty clay.	32.1	90	43	47	1.83	1.33	2.70	3.90	0	0.857	0.183	0.099	0	1	56	43
16	3	SP-3/5	13.00	Mottled dark bluish grey & brownish grey silty clay, with traces of sand.	-	-	-	-	-	-	-	-	-	-	-	-	0	19	58	23
17	3	U-3/4	19.00	Dark grey, silty clay.	29.0	80	37	43	1.91	1.49	-	4.87	-	-	-	-	0	0	60	40
18	3	SP-3/10	25.00	Mottled grey & reddish brown silty clay, with traces of sand.	-	-	-	-	-	-	-	-	-	-	-	-	0	4	59	37
19	3	SP-3/12	30.00	Greyish yellow, sandy silty clay, with traces of silt stone.	-	-	-	-	-	-	-	-	-	-	-	-	17	18	53	12
20	3	SP-3/14	36.00	Yellowish grey, silty clay, with traces of silt stone.	-	48	22	26	-	-	-	-	-	-	-	-	16	6	52	26



LABORATORY TEST RESULTS

Project- Proposed Electrical Control Room near ESP-2, Stage -I, (3 X 200 MW), NTPC, Farakka, Dist.- Murshidabad, W.B.

Sl. No.	BH No.	Sample Ref. No.	DEPTH FROM EGL, m	SOIL DESCRIPTION	NMC (%)	ATTERBERG LIMIT			DENSITY		Specific Gravity	TRI-AXIAL Shear Results		Consolidation Test			Grain Size Distribution			
						Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Bulk Density (M/m ³)	Dry Density (M/m ³)		C-value (M/m ²)	ϕ^0	e ₀	C _c	C _c /(1+e ₀)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
21	4	S-4/1	1.50	Brownish grey clayey sandy silt.	30.6	-	-	-	-	-	-	-	-	-	-	-	0	38	51	11
22	4	S-4/2	3.00		-	-	-	-	-	-	-	-	-	-	-	-	0	46	44	10
23	4	U-4/1	4.50	Mottled dark grey & greyish brown silty clay, with traces of kankar.	30.6	75	31	44	1.84/1.85	1.43/1.44	2.70	3.29/ 3.35	0	0.846	0.258	0.140	0	1	54	45
24	4	U-4/2	7.50		35.0	94	40	54	1.81	1.42	2.71	3.56	0	0.934	0.284	0.147	0	1	47	52
25	4	U-4/3	10.50		33.2	86	34	52	1.8	1.40/1.41	2.71	4.26/ 5.00	0	0.886	0.245	0.130	0	0	50	50
26	4	U-4/4	14.50	Yellowish grey with brownish patches, silty clay.	25.2	48	23	25	1.89	1.54	2.70	5.81	0	0.670	0.157	0.094	0	2	74	24
27	4	S-4/6	16.50	Mottled dark & brown, silty clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	1	73	26
28	4	S-4/8	21.00	Mottled dark & brown, silty clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	1	45	54
29	5	U-5/1	4.00	Brownish grey silty clay, with traces of sand.	24.4	89	34	55	1.82/1.85	1.49/1.52	2.70	5.71/ 5.94	0	0.862	0.152	0.082	0	0	53	47
30	5	U-5/2	8.00	Mottled grey & brown silty clay, with traces of calcareous nodules & kankar.	23.3	-	-	-	1.78	1.30	2.71	3.03	0	0.9300	0.1958	0.101	8	0	45	47
31	5	U-5/3	13.00	Mottled grey & brown silty clay.	36.6	70	40	30	1.82/1.83	1.45	2.72	3.75/ 4.55	0	0.9801	0.2150	0.109	0	2	48	50
32	6	SP-6/2	3.00	Grey sandy silt upto 3.40m. After that it is reddish brown medium grained sand.	-	-	-	-	-	-	-	-	-	-	-	-	0	45	55	0
33	6	U-6/1	4.50	Greyish brown silty clay, with traces of kankars.	32.1	85	33	52	1.81/1.86	1.43/1.52	2.70	4.67/ 5.31	0	0.8568	0.1457	0.0785	0	0	46	54
34	6	SP-6/4	7.50	Brownish grey with brownish patches, silty clay, with traces of kankar.	-	91	42	49	-	-	-	-	-	-	-	-	0	1	47	52
35	6	U-6/2	9.00	Mottled grey & brown, silty clay, with traces of kankar & calcareous nodules.	35.8	88	39	49	1.84	1.42	2.71	6.00	0	0.956	0.256	0.1309	0	2	52	46
36	6	SP-6/5	11.00	Mottled grey & brown, silty clay, with traces of kankar & calcareous nodules.	-	-	-	-	-	-	-	-	-	-	-	-	0	0	42	58
37	6	U-6/3	13.00	Mottled bluish grey & yellowish brown silty clay, with traces of fine sand.	28.8	61	27	34	1.9	1.5	2.70	6.33	0	0.766	0.164	0.0926	0	3	68	29
37	6	SP-6/6	15.00	Grey with brownish patches silty clay.	-	76	35	41	-	-	-	-	-	-	-	-	0	1	68	31



LABORATORY TEST RESULTS

Project:- Proposed Electrical Control Room near ESP-3, Stage -I, (3 X 200 MW), NTPC, Farakka, Dist.- Murshidabad, W.B.

Sl. No.	BH No.	Sample Ref. No.	DEPTH FROM EGL, m	SOIL DESCRIPTION	NMC (%)	ATTERBERG LIMIT			DENSITY		Specific Gravity	TRI-AXIAL Shear Results		Consolidation Test			Grain Size Distribution			
						Liquid Limit (%)	Plastic Limit (%)	Plasticity index (%)	Bulk Density (Mt/m ³)	Dry Density (Mt/m ³)		C-value (Mt/m ²)	ϕ ^o	e ₀	C _c	C _c /1+e ₀	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
38	7	U-7/1	1.50	Yelloweish grey, with rusty patches silty clay, with traces of kankar.	25.9	70	28	42	1.90	1.58	2.70	3.77/3.82	0	0.665	0.147	0.0883	-	-	-	-
39	7	S-7/1	3.00	Dark grey silty clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	2	64	34
40	7	U-7/2	6.00	Mottled dark grey & brown, silty clay.	35.4	106	41	65	1.80/1.81	1.30/1.31	2.71	3.38/ 3.79	0	0.945	0.234	0.1203	0	0	45	55
41	7	U-7/3	9.00	Mottled dark bluish grey & grey silty clay.	36.5	86	38	48	1.84	1.41	2.70	2.94	0	0.9707	0.1824	0.0926	0	1	49	50
42	7	S-7/5	12.50	Brownish grey silty clay, with traces of nodules.	-	-	-	-	-	-	-	-	-	-	-	-	10	6	58	26
43	7	U-7/4	16.50	Grey silty clay.	31.9	69	30	39	1.88	1.44	2.72	6.88		0.8520	0.2061	0.1113	0	0	58	42
44	7	S-7/8	20.50	Dark grey silty clay, with intermittent thin layer of thin silt.	-	-	-	-	-	-	-	-	-	-	-	-	0	1	53	46
45	7	S-7/10	24.50	Dark grey silty clay.	-	89	33	56	-	-	-	-	-	-	-	-	0	0	45	55
46	7	S-7/13	30.50	Greyish yellow clayey silt, with traces of silt stone.	-	-	-	-	-	-	-	-	-	-	-	-	24	12	49	15
47	7	S-7/14	32.50	Yellowish grey clayey silt, with traces of sand & silt stone.	-	-	-	-	-	-	-	-	-	-	-	-	4	30	54	12
48	7	S-7/15	34.50	Greyish brown silty sand with mica.	-	-	-	-	-	-	-	-	-	-	-	-	2	85	13	0
49	7	S-7/16	37.00	Greyish brown medium sand, with silt stone.	-	-	-	-	-	-	-	-	-	-	-	-	11	72	17	0
50	7	S-7/17	40.00	Reddish brown clayey medium sand.	-	51	28	23	-	-	-	-	-	-	-	-	13	65	14	8
51	8	SP-8/1	1.50	Yellowish brown, with bluish patches, silty clay, with traces of calcareous nodules.	-	59	24	35	-	-	-	-	-	-	-	-	0	4	60	36
52	8	SP-8/2	5.50	Grey with brownish patches silty clay.	-	61	25	36	-	-	-	-	-	-	-	-	0	2	69	29
53	8	U-8/2	7.50	Mottled grey & greyish brown, silty clay.	37.1	121	65	56	1.81	1.34	2.70	4.0		0.9920	0.1496	0.0751	0	2	48	50
54	8	SP-8/4	11.50	Yellowish grey with bluish patches, mixed with calcareous nodules.	-	-	-	-	-	-	-	-	-	-	-	-	20	4	56	20
55	8	SP-8/5	15.50	Grey silty clay.	-	-	-	-	-	-	-	-	-	-	-	-	0	0	74	26
56	8	SP-8/7	19.50		-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	46
57	9	SP-9/1	2.00	Yellowish brown with bluish patches, silty clay, with traces of kankar & black moorum.	-	67	26	41	-	-	-	-	-	-	-	-	0	3	67	30
58	9	U-9/1	4.00	Brownish grey & greyish brown silty clay.	32.0	75	36	39	1.85/1.87	1.43/1.45	2.71	3.97/6.20	0	0.8580	0.2112	0.1137	0	3	71	26
59	9	SP-9/2	6.00	Dark bluish grey,with brownish patches, silty clay, with traces of kankar.	-	106	41	65	-	-	-	-	-	-	-	-	0	2	39	59
60	9	U-9/2	10.00	Mottled brownish grey & grey, silty clay.	34.7	98	36	62	1.80	1.37	2.70	4.32	0	0.9270	0.1730	0.0898	0	6	48	46
61	9	SP-9/4	12.00	Yellowish grey & grey, silty clay, with traces of nodules.	-	53	26	27	-	-	-	-	-	-	-	-	0	2	72	26
62	9	SP-9/7	21.00	Bluish grey silty clay.	-	64	26	38	-	-	-	-	-	-	-	-	0	0	64	36
63	9	SP-9/9	27.00	Brownish grey silty clay, with traces of sand.	-	54	23	31	-	-	-	-	-	-	-	-	0	4	60	36
64	9	SP-9/10	30.00	Yellowish brown clayey silt, with traces of sand.	-			0	-	-	-	-	-	-	-	-	3	24	61	12

Chemical Test Results Of Soil Samples

<u>SL No.</u>	<u>BH No.</u>	<u>Depth</u>	<u>pH(°) Value</u>	<u>Chloride (%) as Cl^-</u>	<u>Sulphate (%) as SO_4^{2-}</u>	<u>Sulphide (%) as SO_3^{2-}</u>
1	1	2.00	7.88	0.014	0.001	0.0008
2	4	5.00	7.75	0.018	0.007	0.0059
3	7	1.50	7.97	0.008	0.010	0.0083

Chemical Test Results Of Sub-Soil Samples

<u>SL No.</u>	<u>BH No.</u>	<u>pH(°) Value</u>	<u>Chloride (mg/l) as Cl^-</u>	<u>Sulphate (mg/l) as SO_4^{2-}</u>	<u>Sulphide (mg/l) as SO_3^{2-}</u>
1	1	7.35	36.89	47.73	39.62
2	5	7.30	36.94	47.70	39.55
3	7	7.39	36.80	47.80	38.71

Electrical Resistivity test DATA & RESULT SHEET

Project Name: Renovation & Retrofitting of ESP-1,2 & 3, Stage-I (3X200MW), NTPC, Farakka, West Bengal

Test Date : 2nd February, 2014

Test No. : ERT-1

Test location:

At proposed Electrical Control Room of ESP-1

Sl. No.	Electrode Spacing (a), metre	Potential Difference, (δV), mV	Current, (I), mA	Resistance (Ω), Ohm	Apparent Resistivity, Ohm-m	APPARENT CONDUCTIVITY (mhm)	REMARKS
1	1.0	670	22	30.25	190.0	0.0053	
2	2.0	191	31	6.21	78.0	0.0256	
3	3.0	85	49	1.75	33.0	0.0909	
4	4.0	78	73	1.07	27.0	0.1481	
5	5.0	64	84	0.76	24.0	0.2083	
6	6.0	59	117	0.50	19.0	0.3158	
7	7.0	48	124	0.39	17.0	0.4118	
8	8.0	33	108	0.31	15.4	0.5195	
9	9.0	29	115	0.25	14.2	0.6338	
10	10.0	20	92	0.22	13.6	0.7353	

Project Name: Renovation & Retrofitting of ESP-1,2 & 3, Stage-I (3X200MW), NTPC, Farakka, West Bengal

Test Date : 17th February, 2014

Test No. : ERT-2

Test location:

At proposed Electrical Control Room of ESP-2

Sl. No.	Electrode Spacing (a), metre	Potential Difference, (δV), mV	Current, (I), mA	Resistance (Ω), Ohm	Apparent Resistivity, Ohm-m	APPARENT CONDUCTIVITY (mho/m)	REMARKS
1	1.0	1237	27	45.70	287.0	0.0035	
2	2.0	238	32	7.48	94.0	0.0213	
3	3.0	153	90	1.70	32.0	0.0938	
4	4.0	95	99	0.96	24.0	0.1667	
5	5.0	135	193	0.70	22.0	0.2273	
6	6.0	50	113	0.44	16.7	0.3593	
7	7.0	61	192	0.32	14.0	0.5000	
8	8.0	54	217	0.25	12.5	0.6400	
9	9.0	41	202	0.20	11.5	0.7826	
10	10.0	39	223	0.18	11.0	0.9091	

Electrical Resistivity test DATA & RESULT SHEET

Project Name: Renovation & Retrofitting of ESP-1,2 & 3, Stage-I (3X200MW), NTPC, Farakka, West Bengal

Test Date : 23rd February, 2014

Test No. : ERT-3

Test location:

At proposed Electrical Control Room of ESP-3

Sl. No.	Electrode Spacing (a), metre	Potential Difference, (δV), mV	Current, (I), mA	Resistance (Ω), Ohm	Apparent Resistivity, Ohm-m	APPARENT CONDUCTIVITY (mho/m)	REMARKS
1	1.0	1542	23	66.24	416.0	0.0024	
2	2.0	987	258	3.83	48.1	0.0416	
3	3.0	214	212	1.01	19.0	0.1579	
4	4.0	195	306	0.64	16.0	0.2500	
5	5.0	163	366	0.45	14.0	0.3571	
6	6.0	149	453	0.33	12.4	0.4839	
7	7.0	133	500	0.27	11.7	0.5983	
8	8.0	96	431	0.22	11.2	0.7143	
9	9.0	85	429	0.20	11.2	0.8036	
10	10.0	43	245	0.18	11.0	0.9091	

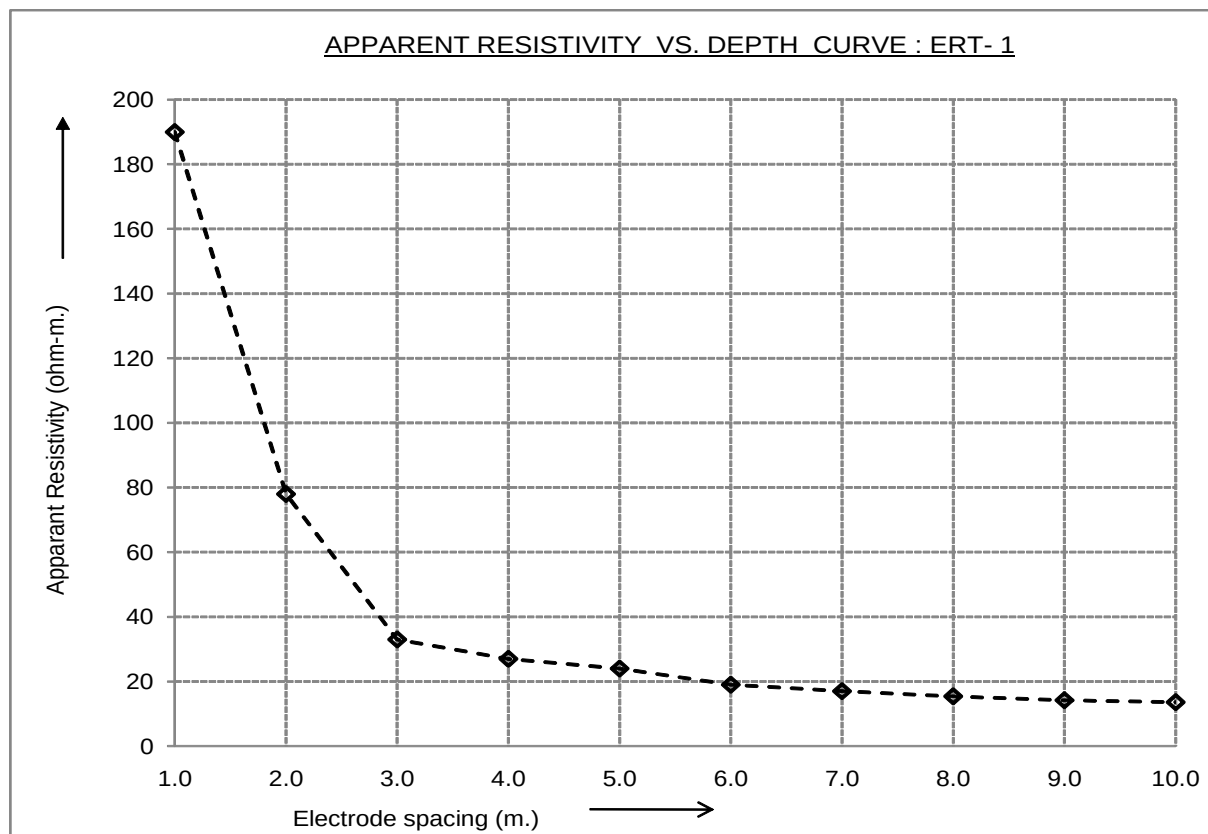


TABLE 1: LABORATORY TEST RESULTS

Bore Hole No.	Type	Depth (m)	Standard Penetration Resistance 'N' value	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry density(gm/c.c.)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	Permiability (cm/sec)	Free Swell Index (%)	IS Classification	Type of Test	Co-hesion (kg/cm ²)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm ²)	m _v (cm ² /kg)
BH-5	U	3.00	-	-	2.64	62.3	35.1	25.6	1.848	1.471	48.6	24.9	23.7	5.9E-07	5.1	CI	UU	0.37	2.0	2.65	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0224 0.0180 0.0137 0.0102 0.0064
	U	6.00	-	-	2.51	61.8	35.7	24.3	1.884	1.516	50.3	26.4	23.9	5.9E-07	4.0	CH	UU	0.64	3.0	2.64	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0192 0.0161 0.0130 0.0090 0.0054
	U	9.00	-	-	2.61	63.2	34.2	23.2	1.898	1.541	49.8	25.6	24.2			CI	UU	0.72	4.0	2.67		
	U	12.00	-	-	2.72	61.7	35.6	19.9	1.900	1.585	50.3	25.8	24.5			CH	UU	0.94	5.0	2.66		
	U	15.00	-	-	2.84	64.7	32.5	17.6	1.905	1.620	48.6	25.0	23.6			CI	UU	1.21	5.0	2.67	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0175 0.0159 0.0118 0.0078 0.0047
	U	18.00	-	-	2.74	63.9	33.4	17.8	1.924	1.633	49.4	25.3	24.1			CI	UU	1.31	5.0	2.68		
	U	21.00	-	-	2.64	62.6	34.8	19.7	1.952	1.631	50.6	25.8	24.8			CH	UU	1.10	5.0	2.66		
	P	24.00	54	-	88.76	11.2						Non-Plastic				SW-SM						
	P	27.00	50	-	88.12	11.9						Non-Plastic				SW-SM						
	P	30.00	61	-	90.24	9.8						Non-Plastic				SW-SM						
	P	33.00	51	-	91.63	8.4						Non-Plastic				SW-SM						
	P	36.00	44	-	89.61	10.4						Non-Plastic				SW-SM						

* Silt & Clay

UC: Unconfined Compression Test
UU: Unconsolidation Undrained Test

TABLE 1: LABORATORY TEST RESULTS

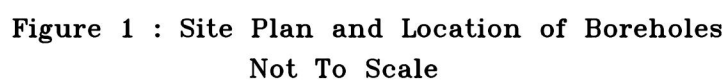
Bore Hole No.	Type	Depth (m)	Standard Penetration Resistance 'N' value	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry density(gm/c.c.)	Liquid Limit(%)	Plastic Limit (%)	Plasticity Index (%)	Permiability (cm/sec)	Free Swell Index (%)	IS Classification	Type of Test	Co-hesion (kg/cm ²)	Angle of Friction (degree)	Sp.Gravity	Pressure Range (kg/cm ²)	m _v (cm ² /kg)
BH-6	U	3.00	-	-	2.35	61.3	36.4	25.3	1.846	1.473	51.0	26.1	24.9	2.8E-07	3.5	CH	UU	0.35	2.0	2.66	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0233 0.0192 0.0156 0.0107 0.0066
	U	6.00	-	-	2.12	60.5	37.4	24.3	1.876	1.509	52.6	26.9	25.7			CH	UU	0.50	3.0	2.66		
	U	9.00	-	-	2.74	64.2	33.1	20.9	1.887	1.561	48.3	24.9	23.4			CI	UU	0.79	4.0	2.65	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0178 0.0145 0.0118 0.0083 0.0049
	U	12.00	-	-	2.51	62.8	34.7	19.8	1.899	1.585	51.2	26.8	24.4			CH	UU	1.07	4.0	2.67		
	U	15.00	-	-	2.64	63.6	33.8	21.3	1.924	1.586	48.4	24.8	23.6	1.6E-08	5.3	CI	UU	0.97	3.0	2.65	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0170 0.0151 0.0119 0.0089 0.0054
	U	18.00	-	-	2.89	64.8	32.3	18.6	1.910	1.610	47.3	24.6	22.7			CI	UU	0.93	5.0	2.66		
	U	21.00	-	-	3.03	63.9	33.1	17.6	1.922	1.634	47.2	24.9	22.3			CI	UU	1.05	5.0	2.67	0.25-0.5 0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	0.0160 0.0137 0.0109 0.0079 0.0049
	P	24.00	30	-	8.24	67.9	23.9				26.9	14.6	12.3			CL						
	P	27.00	82	-	91.36	8.6					Non-Plastic					SW-SM						
	P	30.00	59	-	88.25	11.8					Non-Plastic					SW-SM						
	P	33.00	62	-	87.36	12.6					Non-Plastic					SM						
	P	37.50	38	2.21	7.10	65.3	25.4				30.1	15.6	14.5			CL						

* Silt & Clay

Chemical Test Results

Borehole No.	Chemical Tests on Soil samples				Chemical Tests on Water samples		
	Depth (m)	pH Value	Chloride (%)	Sulphate (%)	pH Value	Chloride (mg/litre)	Sulphate (mg/litre)
BH-1	3.00	6.84	0.0072	0.25	7.2	19.5	58.0
BH-2	1.50	6.58	0.0069	0.24	7.3	19.8	61.0
BH-3	4.50	6.74	0.0073	0.25	7.0	19.2	59.0
BH-4	6.00	6.64	0.0071	BDL	7.3	19.6	65.0
BH-5	3.00	6.82	0.0074	0.26	7.2	19.9	61.0
BH-6	6.00	6.90	0.0073	BDL	7.1	19.5	60.0

BDL= Below Detection Limit



RESULTS OF CHEMICAL ANALYSIS OF SOIL SAMPLES

Sl. No.	Bore Hole No.	Sample No.	Depth of below existing ground surface (m)	pH value	Type of test conducted					
					Carbonate (as CO ₃) (%)	Sulphate		Chloride (as CL) (%)	Nitrate (NO ₃) (%)	Organic matter (%)
						(as SO ₃) (%)	(as SO ₄) (%)			
1	BH-1	UDS-2	3.50 - 3.90	6.7	7.62	0.0164	0.0198	0.0275	0.0260	0.086
2	BH-8	UDS-3	6.50 - 6.90	6.8	7.18	0.0246	0.0297	0.0200	0.0310	0.112
3	BH-12	UDS-3	4.50 - 4.90	6.6	6.86	0.0274	0.0330	0.0225	0.0190	0.106
4	BH-18	UDS-3	6.50 - 6.90	6.8	7.39	0.0219	0.0264	0.0175	0.0300	0.132
5	BH-26	UDS-1	0.50 - 0.90	6.8	7.28	0.0246	0.0297	0.0250	0.0220	0.136
6	BH-29	UDS-1	0.50 - 0.90	6.6	7.20	0.0274	0.0330	0.0150	0.0180	0.143
7	BH-43	UDS-2	3.50 - 3.90	6.8	7.14	0.0260	0.0313	0.0225	0.0250	0.098
8	BH-49	DS-1	0.00 - 0.50	6.8	6.73	0.0251	0.0302	0.0300	0.0320	0.087
9	BH-55	UDS-1	0.50 - 0.90	6.9	6.88	0.0237	0.0286	0.0280	0.0270	0.093
10	BH-82	UDS-1	1.50 - 1.90	6.7	7.16	0.0287	0.0346	0.0325	0.0210	0.118
11	BH-89	UDS-1	0.50 - 0.90	6.6	7.48	0.0225	0.0271	0.0270	0.0320	0.103
12	BH-96	UDS-1	1.50 - 1.90	6.8	7.21	0.0267	0.0322	0.0315	0.0280	0.096
13	BH-110	UDS-1	2.50 - 2.90	6.8	6.72	0.0241	0.0291	0.0286	0.0310	0.113
14	BH-118	UDS-2	5.00 - 5.40	6.7	6.87	0.0262	0.0316	0.0345	0.0260	0.088
15	BH-124	UDS-2	3.50 - 3.90	6.8	7.17	0.0256	0.0309	0.0320	0.0200	0.121
16	BH-132	UDS-3	6.50 - 6.90	6.6	6.92	0.0221	0.0266	0.0295	0.0280	0.118
17	BH-144	UDS-2	4.00 - 4.40	6.7	6.78	0.0235	0.0283	0.0338	0.0330	0.150
18	BH-156	UDS-1	2.00 - 2.40	6.9	7.11	0.0287	0.0346	0.0296	0.0290	0.148
19	BH-164	UDS-2	5.00 - 5.40	6.8	7.28	0.0266	0.0320	0.0348	0.0260	0.113
20	BH-170	UDS-2	4.50 - 4.90	6.8	7.42	0.0240	0.0289	0.0285	0.0310	0.096

RESULTS OF ELECTRICAL RESISTIVITY TESTS

TEST LOCATION NO. : ERT-9

LOCATION CO-ORDINATE : 2180 S, 3550 E

Spacing of Electrode (m)	Resistance (R) Ohms Directions		Average Resistivity P (Ohm - meter) P = 2KSR Where K = 3.14159	
	N-S	E-W	N-S	E-W
0.50	5.03	4.16	15.80	13.07
1.00	0.96	0.90	6.03	5.65
2.00	0.14	0.13	1.76	1.63
3.00	0.08	0.09	1.51	1.70
4.00	0.06	0.06	1.51	1.51
5.00	0.05	0.05	1.57	1.57
6.00	0.04	0.04	1.51	1.51
7.50	0.04	0.03	1.88	1.41
10.00	0.02	0.01	1.26	0.63

TEST LOCATION NO. : ERT-13

LOCATION CO-ORDINATE : 2065 S, 3490 E

Spacing of Electrode (m)	Resistance (R) Ohms Directions		Average Resistivity P (Ohm - meter) P = 2KSR Where K = 3.14159	
	N-S	E-W	N-S	E-W
0.50	3.74	3.48	11.75	10.93
1.00	1.71	1.55	10.74	9.74
2.00	0.77	0.74	9.68	9.30
3.00	0.52	0.48	9.80	9.05
4.00	0.39	0.36	9.80	9.05
5.00	0.35	0.32	11.00	10.05
6.00	0.27	0.26	10.18	9.80
7.50	0.19	0.16	8.95	7.54
10.00	0.15	0.10	9.42	6.28

TEST LOCATION NO. : ERT-23

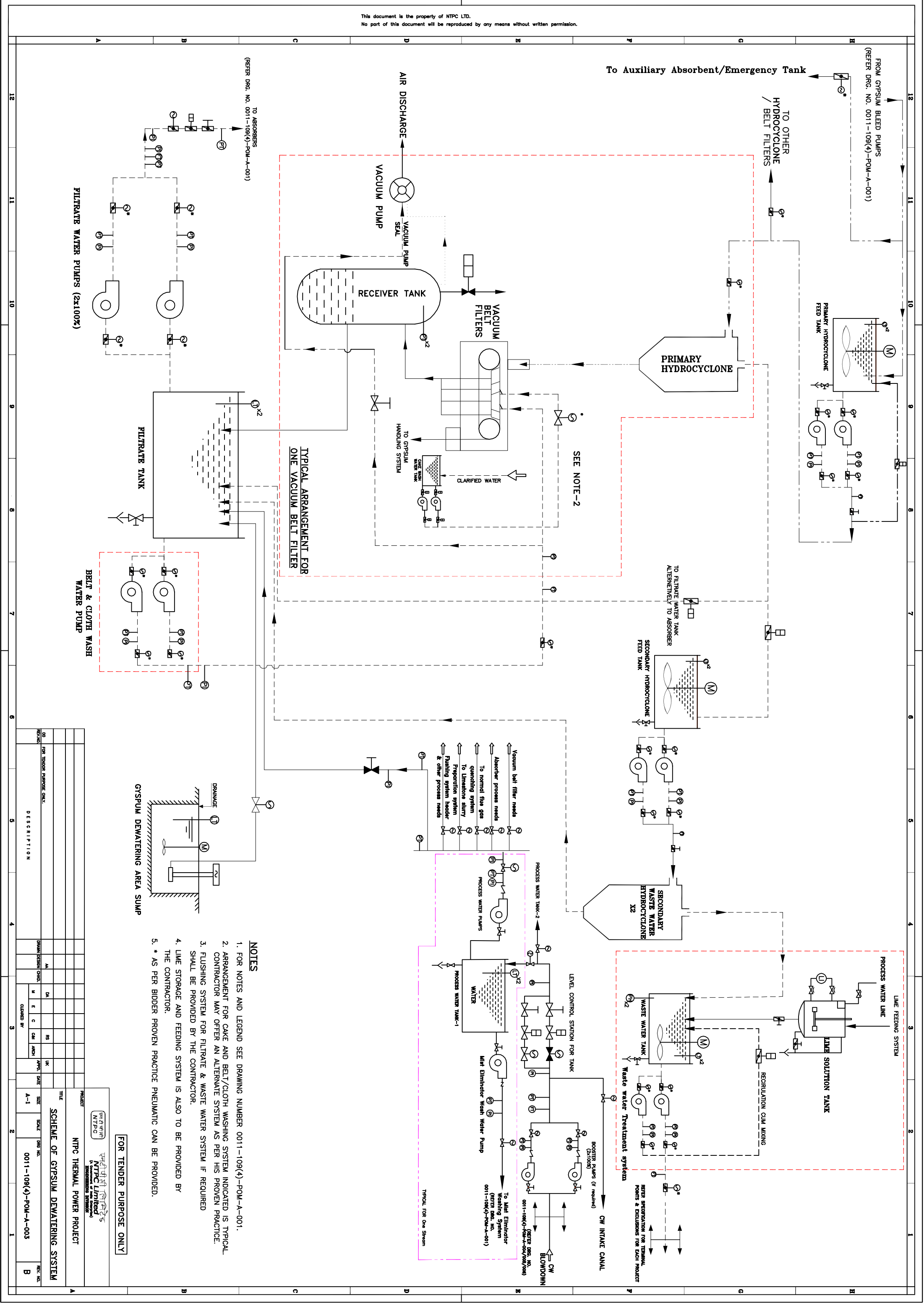
LOCATION CO-ORDINATE : 1210 S, 3950 E

Spacing of Electrode (m)	Resistance (R) Ohms Directions		Average Resistivity P (Ohm - meter) P = 2KSR Where K = 3.14159	
	N-S	E-W	N-S	E-W
0.50	2.75	1.83	8.64	5.75
1.00	1.49	1.55	9.36	9.74
2.00	0.74	0.69	9.30	8.67
3.00	0.41	0.66	7.73	12.44
4.00	0.30	0.35	7.54	8.80
5.00	0.16	0.26	5.03	8.17
6.00	0.09	0.11	3.39	4.15
7.50	0.07	0.08	3.30	3.77
10.00	0.04	0.05	2.51	3.14

TEST LOCATION NO. : ERT-24

LOCATION CO-ORDINATE : 1300 S, 3750 E

Spacing of Electrode (m)	Resistance (R) Ohms Directions		Average Resistivity P (Ohm - meter) P = 2KSR Where K = 3.14159	
	N-S	E-W	N-S	E-W
0.50	3.35	3.10	10.52	9.74
1.00	2.18	1.98	13.70	12.44
2.00	1.10	1.00	13.82	12.57
3.00	0.60	0.52	11.31	9.80
4.00	0.41	0.34	10.30	8.55
5.00	0.31	0.26	9.74	8.17
6.00	0.22	0.17	8.29	6.41
7.50	0.12	0.09	5.65	4.24
10.00	0.06	0.04	3.77	2.51

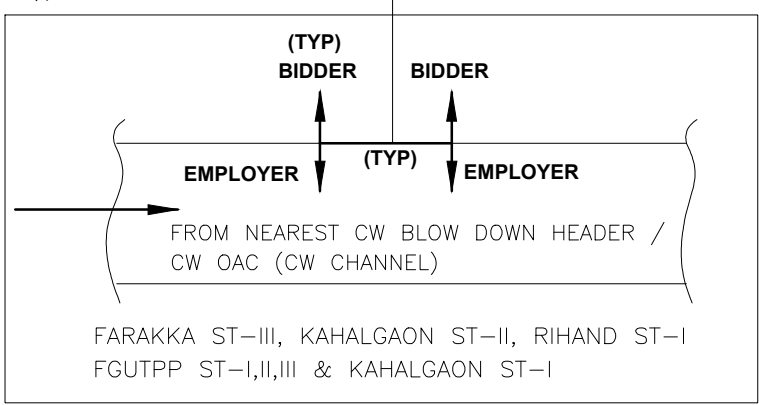
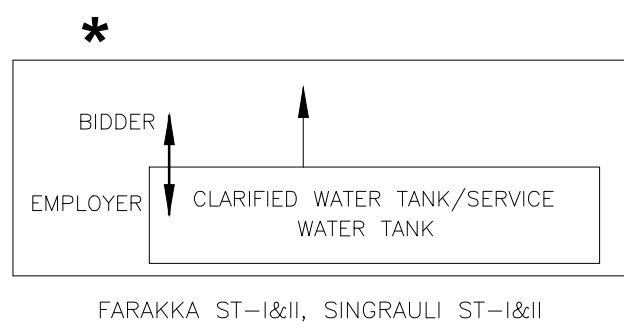
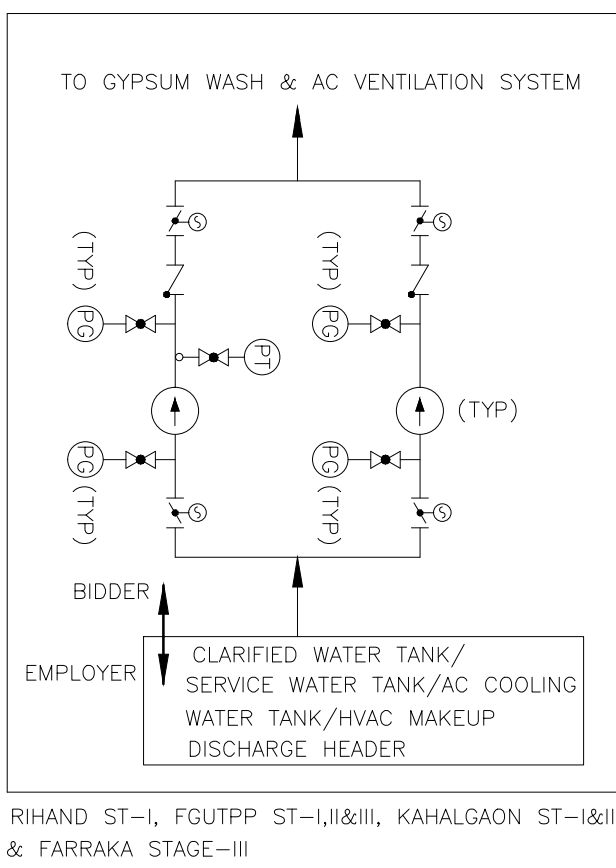
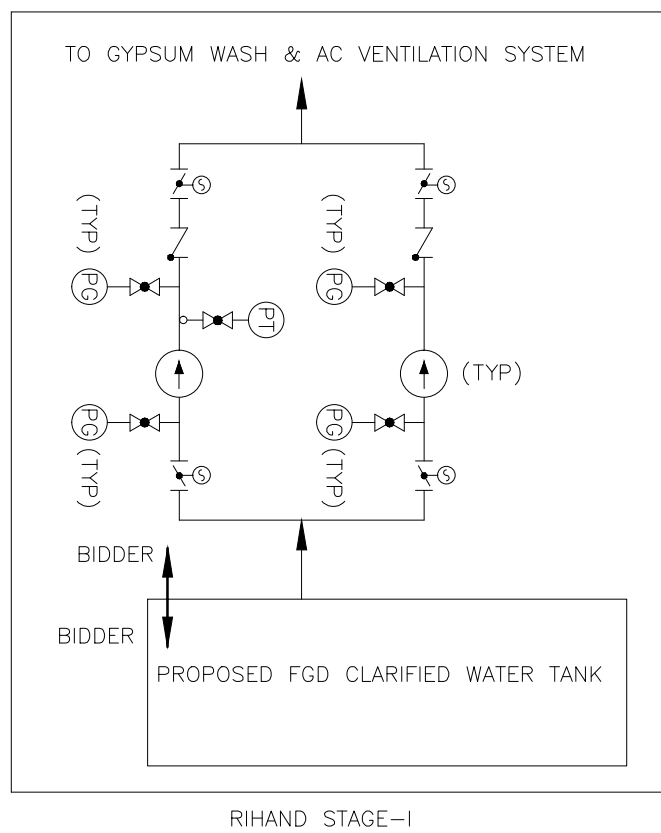
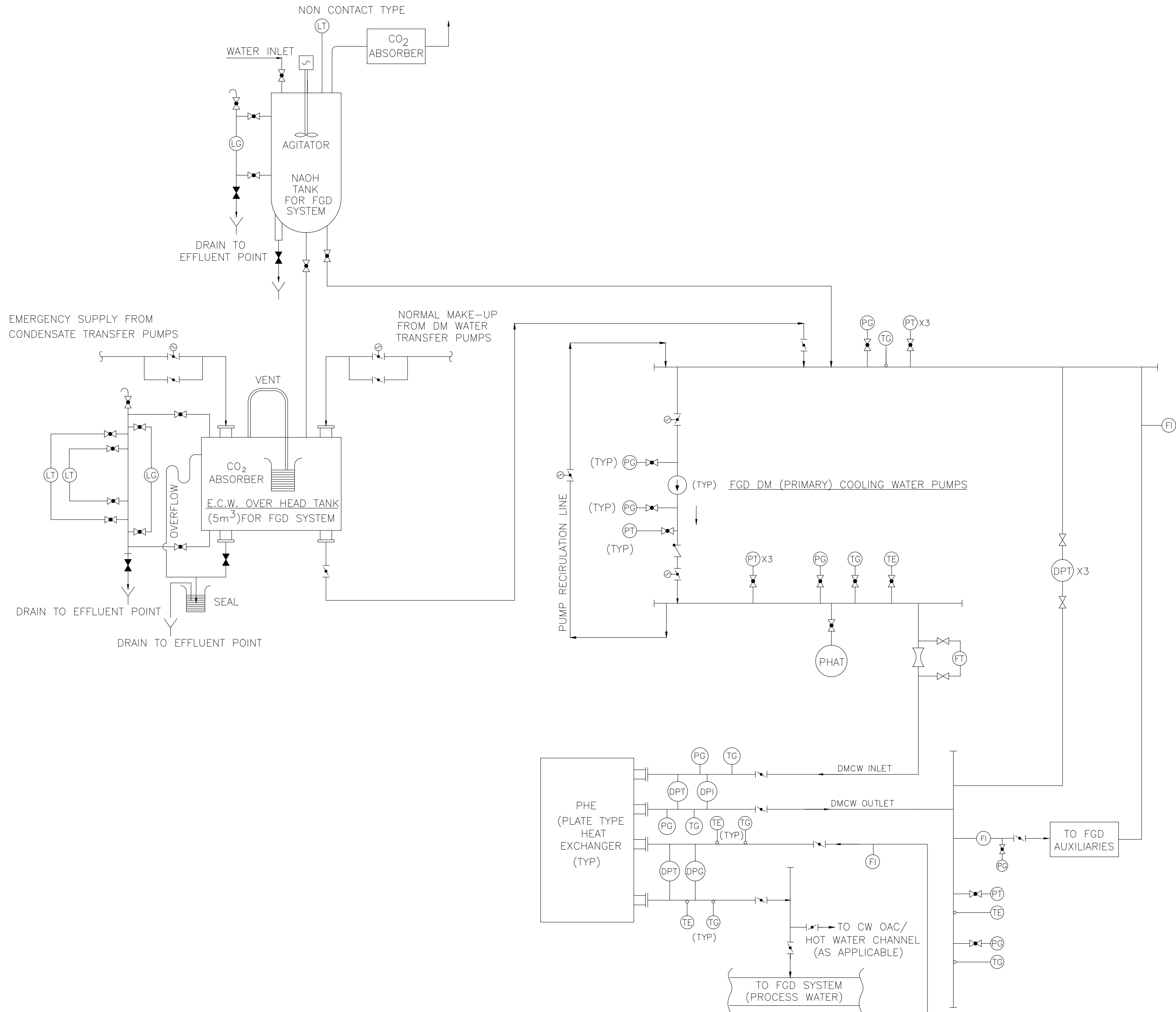


PROJECT													NTPC THERMAL POWER PROJECT												
TITLE													SCHEME OF GYPSUM DEWATERING SYSTEM												
NO FOR TENDOR PURPOSE ONLY.													REV. NO.												
DRAWN DESIGN CHGO.													0011-109(4)-P-A-003												
DESCRIPTION													B												
3													4												
3													2												
1													1												

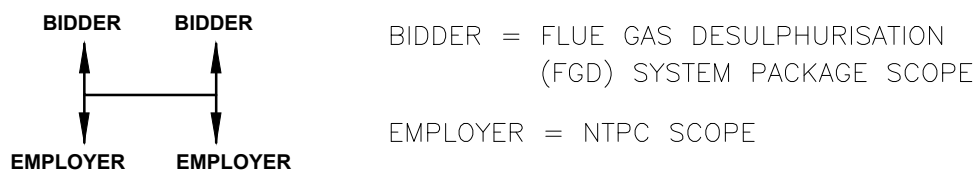
 एन टी सी लिमिटेड NTPC Limited १००% Government of India			
FOR TENDER PURPOSE ONLY			
PROJECT NTPC THERMAL POWER PROJECT			
TITLE SCHEME OF GYPSUM DEWATERING SYSTEM			
SIZE	SCALE	DWG NO.	REV. NO.
A-1		0011-109(4)-POM-A-003	B
2		1	

LEGEND :

1.		GLOBE VALVE
2.		NON-RETURN VALVE
3.		BUTTERFLY VALVE
4.		MOTOR OPERATED BUTTERFLY VALVE
5.		FLOW INDICATOR (ROTOMETER TYPE)
6.		FILTER
7.		STRAINER
8.		PUMP
9.		PRESSURE GAUGE
10.		TEMPERATURE GAUGE
11.		DIFFERENTIAL PR. GAUGE
12.		TEMPERATURE ELEMENT
13.		PRESSURE TRANSMITTER
14.		OPEN LIMIT SWITCH
15.		LEVEL TRANSMITTER
16.		LEVEL GAUGE / LEVEL SWITCH
17.		DIFFERENTIAL PRESSURE TRANSMITTER
18.		pH SENSOR
19.		pH ANALYSER TRANSMITTER
20.		FLOW ELEMENT (ORIFICE)
21.		CONTROL VALVE (PNEUMATIC ACTUATOR)
22.		NORMALLY CLOSED VALVE
23.		FLOW TRANSMITTER



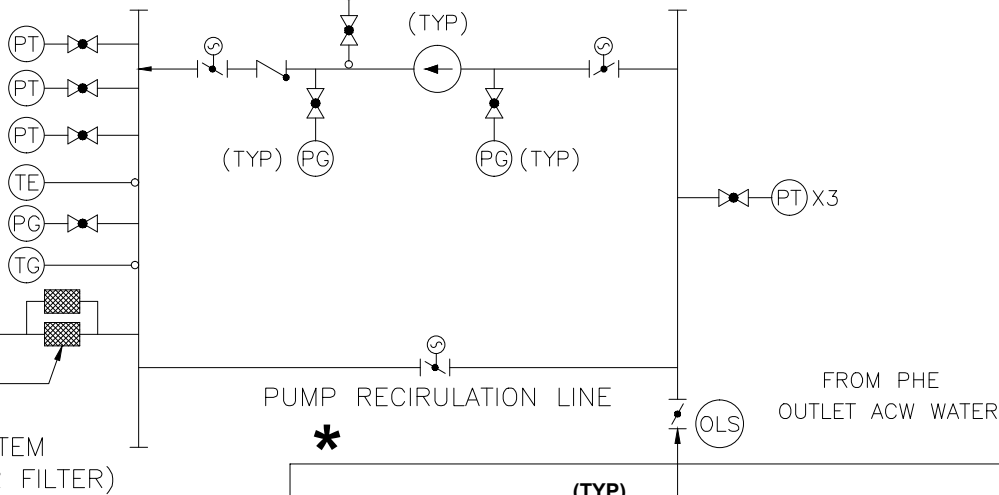
LEGENDS :



GENERAL NOTES :

- INDICATIVE SCHEME FOR ECW SYSTEM IS SHOWN FOR THE FGD
- ALL DRAIN AND VENT. CONNECTIONS SHALL BE PROVIDED WITH VALVES AT REQUIRED POINTS/LOCATIONS AS PER LAYOUT.
- pH OF PRIMARY CIRCUIT DM WATER SHALL BE MAINTAINED AROUND 9.5.
- INSTRUMENTS ARE SHOWN ONLY FOR ONE SET OF PUMP, PHE (PLATE HEAT EXCHANGER) OR ONE HEADER AS THE CASE MAY BE FOR CLARITY AND ARE TYPICAL. THE SAME SHALL BE PROVIDED FOR ALL THE EQUIPMENTS AND HEADERS.
- ROOT VALVE, ISOLATION VALVES, THREE WAY MANIFOLD ETC. REQUIRED FOR VARIOUS INSTRUMENTS SHALL BE PROVIDED BY BIDDER.
- EACH HEAT EXCHANGER/Cooler OF VARIOUS AUXILIARIES SHALL BE PROVIDED WITH TEMPERATURE GAUGE AT INLET AND OUTLET BY THE RESPECTIVE BIDDER (COOLER SUPPLIER). FURTHER FLOW GLASS AT INLET SHALL ALSO BE PROVIDED BY COOLER SUPPLIER.
- WINDING & BEARINGS TEMP MEASUREMENTS OF PUMPS AND MOTORS TO BE PROVIDED AS PER SPECIFICATION.
- IN P&ID AT PUMP/PHEs, SUCTION AND DISCHARGE MOTOR OPERATED BUTTERFLY VALVE HAS BEEN INDICATED. HOWEVER, BIDDER CAN ALTERNATIVELY PROVIDE MOTOR OPERATED GATE VALVE AT PUMP/PHEs, SUCTION & DISCHARGE.
- ALL THE INSTRUMENTS SHALL BE IN THE SCOPE OF THE BIDDER. MEASURING INSTRUMENTS INDICATED IN THE P&ID ARE MINIMUM THAT ARE REQUIRED TO BE PROVIDED BY THE BIDDER. IN CASE ADDITIONAL INSTRUMENTS ARE REQUIRED AS PER THE STANDARD AND PROVEN PRACTICE OF BIDDER, THE SAME SHALL BE SUPPLIED WITH IN THIS CONTRACT.
- TOTAL NOS. OF FGD AUXILIARY (SECONDARY) COOLING WATER PUMPS, FGD DM (PRIMARY) COOLING WATER PUMPS & PHE'S HAVE BEEN SPECIFIED IN PART-A TECHNICAL SPECIFICATION.

FGD AUXILIARY (SECONDARY) COOLING WATER PUMPS



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NTPC

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NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

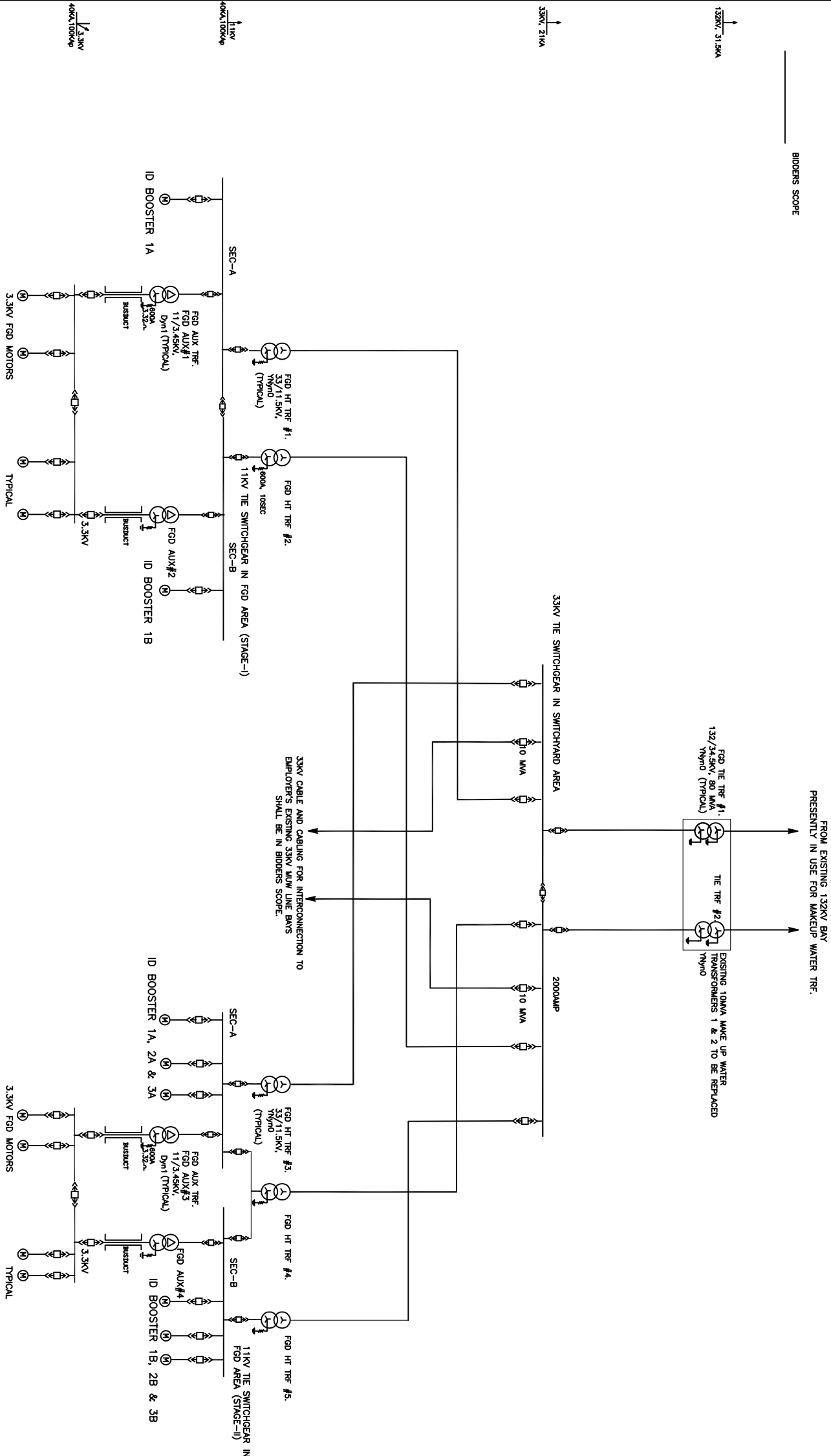
PROJECT FGUTPP ST-I,II & III (2X210)+(2X210MW)+(1X210) FARAKKA ST-I,II,III (3X200MW)+(3X500MW)+(1X500) KAHALGAON ST-I & II (4X210+3X500MW) RIHAND ST-I (2X500) SINGRAULI ST-I & II (5X200)+(2X500MW)

TITLE
P&ID DIAGRAM FOR ECW SYSTEM FOR FGD SYSTEM PACKAGE

SIZE A2	SCALE	DRG.NO. 0011-109(4)-POM-A-004	REV. B

EXISTING

BIDDERS SCOPE

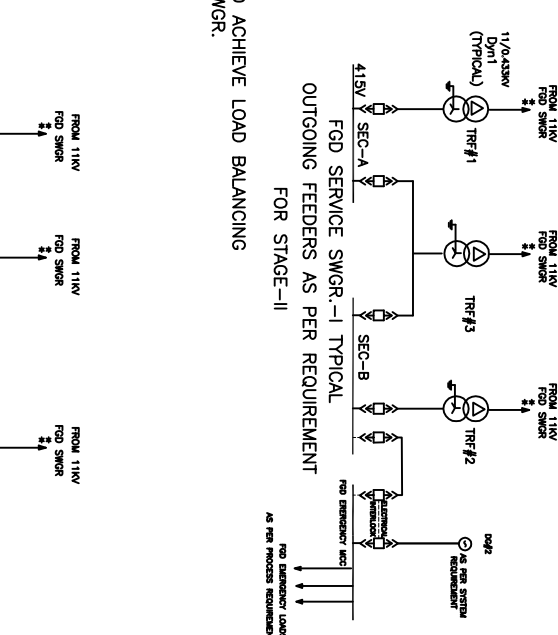
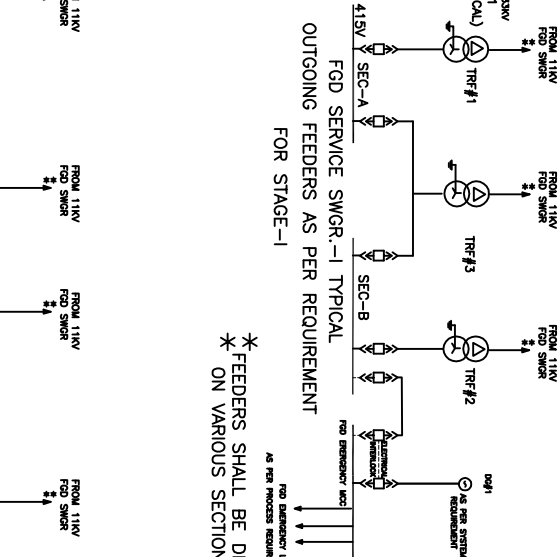
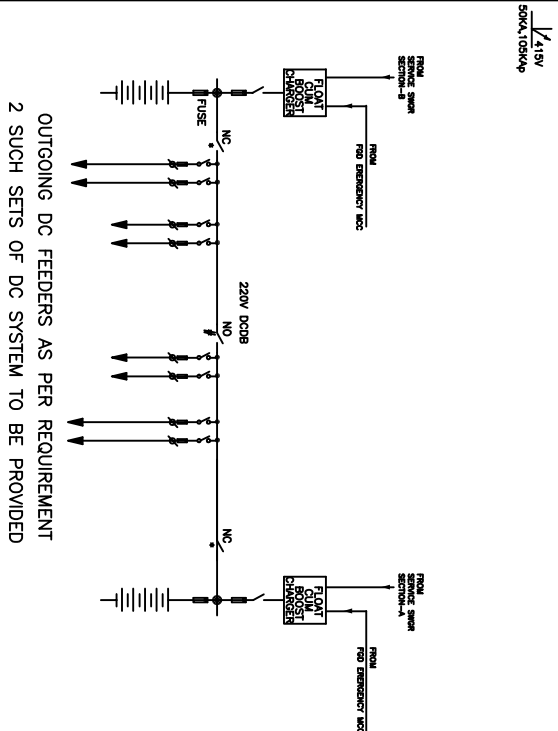


GENERAL NOTES:

- THE SELECTION OF LT FEEDERS SHALL BE AS INDICATED HEREUNDER:
(i) BELOW 100 A – SFU
(ii) 100 A-400 A – MCCB
(iii) ABOVE 400 A – BREAKER
- CONTROL AND PROTECTION SUPPLIES FOR ALL SWITCHGEARS/ DBS/CONTROL PANELS SHALL BE FED FROM TWO DIFFERENT SOURCES/DIFFERENT SECTIONS.
- STANDARD LT TRANSFORMER RATINGS ACCEPTABLE TO OWNER ALONG WITH IMPEDANCES ARE INDICATED BELOW.

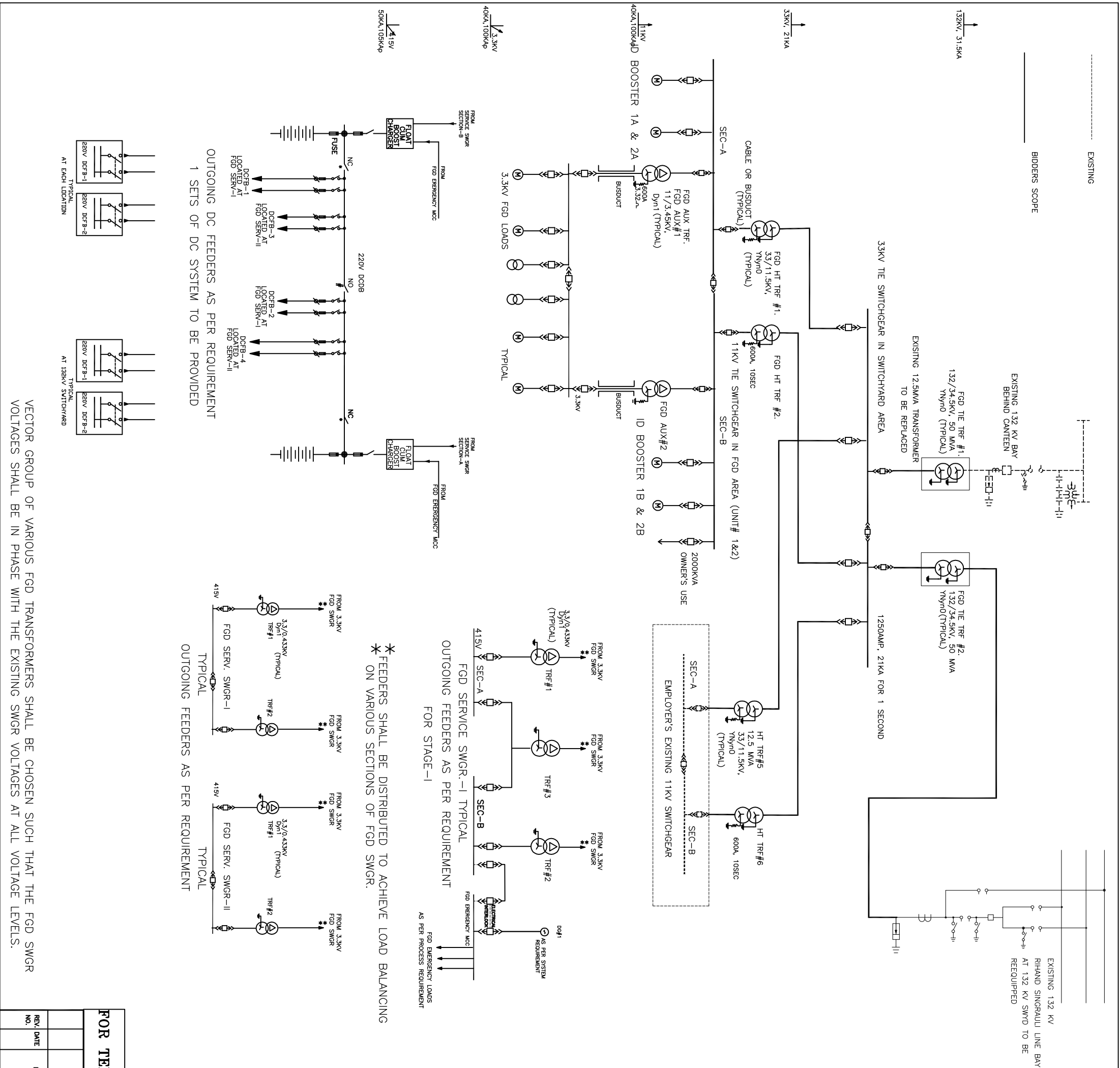
SL. NO.	TRF RATING	% IMPEDANCE (Tolerance as per IS)
1.	2.5 MVA	12 %
2.	2.0 MVA	10 %
3.	1.6 MVA	8 %
4.	1.0 MVA	5 %
5.	0.63 MVA	5 %

- WHEREVER NO RATING HAS BEEN INDICATED, SIZING SHALL BE CARRIED OUT AS PER SYSTEM REQUIREMENT AND FINAL DRIVE LIST. FINAL FEEDING ARRANGEMENT TO BE DECIDED DURING DETAILED ENGINEERING AS PER SIZING CRITERIA SPECIFIED IN THE TECHNICAL SPECIFICATION.
- 3x50% FEEDING ARRANGEMENT MAY BE USED FOR 415 VOLTS LOAD CENTERS WHERE THE TOTAL LT LOAD IS MORE THAN 2.15 MVA.
- NUMBER OF MOTORS/FEEDERS SHOWN IN THE SLD IS TYPICAL AND FEEDING ARRANGEMENT SHOWN AT VARIOUS LOAD CENTERS IS INDICATIVE IN NATURE SHOWING THE FUNCTIONAL REQUIREMENTS.
- BIDDER SHALL PROVIDE MINIMUM 2 NOS. DC SYSTEM OF ADEQUATE CAPACITY FOR MEETING DC LOADS IN FGD AREA.
- TWO NUMBER DG SET FOR ENTIRE FGD PLANT SHALL BE PROVIDED BY THE BIDDER FOR MEETING THE EMERGENCY PROCESS LOADS ENVISAGED FOR FGD PLANT.
- ALL BATTERY CHARGERS SHALL HAVE 2 INPUT SUPPLIES ALONG WITH SUITABLE AUTOMATIC CHANGEOVER BETWEEN THE SOURCES.
- 11/0.433KV SERVICE TRF SHALL BE OUTDOOR OIL FILLED OR INDOOR DRY TYPE.
- SPARES SHALL BE PROVIDED IN HT/LT SWGR. AS PER REQUIREMENTS OF TECHNICAL SPECIFICATIONS.



* FEEDERS SHALL BE DISTRIBUTED TO ACHIEVE LOAD BALANCING
ON VARIOUS SECTIONS OF FGD SWGR.

FOR TENDER PURPOSE ONLY				TITLE ELECTRICAL SINGLE LINE DIAGRAM FOR FGD PACKAGE KAHALGAON STPP STAGE-I AND II			
PROJECT BULK FGD LOT-IV				DRAWN DESIGN CHD APPD AS MS			
PRODUCT NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)				SCALE DRAWING NO. 0011-109(4)-P08-J-001/C			
REV/ DATE				REV. NO. C			
DESCRIPTION				REV. NO. C			
DRAWN DESIGN CHD APPD AS MS				SCALE DRAWING NO. 0011-109(4)-P08-J-001/C			



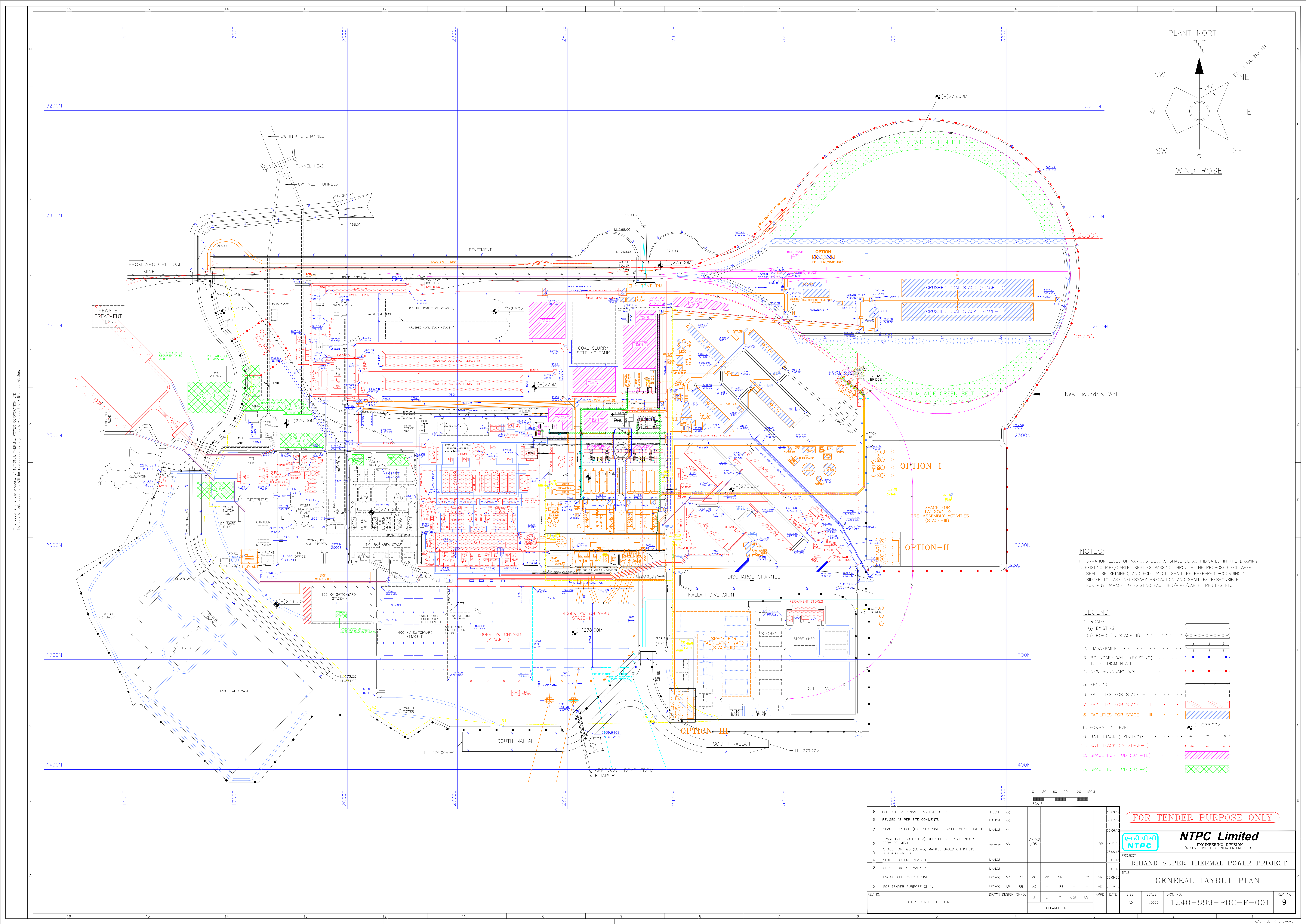
GENERAL NOTES:

1. THE SELECTION OF LT FEEDERS SHALL BE AS INDICATED HEREUNDER:
(i) BELOW 100 A – SFU
(ii) 100 A-400 A – MCCB
(iii) ABOVE 400 A – BREAKER
2. CONTROL AND PROTECTION SUPPLIES FOR ALL SWITCHGEARS/ DBS/CONTROL PANELS SHALL BE FED FROM TWO DIFFERENT SOURCES/DIFFERENT SECTIONS.
3. STANDARD LT TRANSFORMER RATINGS ACCEPTABLE TO OWNER ALONG WITH IMPEDANCES ARE INDICATED BELOW.

SL NO.	TRF RATING	% IMPEDANCE (Tolerance as per IEC)
1.	2.5 MVA	12 %
2.	2.0 MVA	10 %
3.	1.6 MVA	8 %
4.	1.0 MVA	5 %
5.	0.63 MVA	5 %

4. WHEREVER NO RATING HAS BEEN INDICATED, SIZING SHALL BE CARRIED OUT AS PER SYSTEM REQUIREMENT AND FINAL DRIVE LIST. FINAL FEEDING ARRANGEMENT TO BE DECIDED DURING DETAILED ENGINEERING AS PER SIZING CRITERIA SPECIFIED IN THE TECHNICAL SPECIFICATION.
5. 3x50% FEEDING ARRANGEMENT MAY BE USED FOR 415 VOLTS LOAD CENTERS WHERE THE TOTAL LT LOAD IS MORE THAN 2.15 MVA.
6. NUMBER OF MOTORS/FEEDERS SHOWN IN THE SLD IS TYPICAL AND FEEDING ARRANGEMENT SHOWN AT VARIOUS LOAD CENTERS IS INDICATIVE IN NATURE SHOWING THE FUNCTIONAL REQUIREMENTS.
7. BIDDER SHALL PROVIDE 1 NOS. DC SYSTEM OF ADEQUATE CAPACITY FOR MEETING DC LOADS IN FGD AREA.
8. ONE NUMBER DG SET FOR ENTIRE FGD PLANT SHALL BE PROVIDED BY THE BIDDER FOR MEETING THE EMERGENCY PROCESS LOADS ENVISAGED FOR FGD PLANT.
9. ALL BATTERY CHARGERS SHALL HAVE 2 INPUT SUPPLIES ALONG WITH SUITABLE AUTOMATIC CHANGEOVER BETWEEN THE SOURCES.
10. 3.3/0.433kV SERVICE TRF SHALL BE OUTDOOR OIL FILLED OR INDOOR DRY TYPE.
11. SPARES SHALL BE PROVIDED IN HT/LT SWGR. AS PER REQUIREMENTS OF TECHNICAL SPECIFICATIONS.

FOR TENDER PURPOSE ONLY				PROJECT			
				BULK FGD LOT-IV			
				TITLE			
				ELECTRICAL SINGLE LINE DIAGRAM FOR FGD PACKAGE			
				RIHAND STPP-1			
				REV. NO.			
				C			



NOTES:

- FORMATION LEVEL OF VARIOUS BLOCKS SHALL BE AS INDICATED IN THE DRAWING.
- EXISTING PIPE/CABLE TRESTLES PASSING THROUGH THE PROPOSED FGD AREA SHALL BE RETAINED, AND FGD LAYOUT SHALL BE PREPARED ACCORDINGLY. BIDDER TO TAKE NECESSARY PRECAUTION AND SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING FACILITIES/PIPE/CABLE TRESTLES ETC.

- LEGEND:
- 1. ROADS
 - (i) EXISTING
 - (ii) ROAD (IN STAGE-II)
 - 2. EMBANKMENT
 - 3. BOUNDARY WALL (EXISTING) TO BE DISMANTLED
 - 4. NEW BOUNDARY WALL
 - 5. FENCING
 - 6. FACILITIES FOR STAGE - I
 - 7. FACILITIES FOR STAGE - II
 - 8. FACILITIES FOR STAGE - III
 - 9. FORMATION LEVEL (+)275.00M
 - 10. RAIL TRACK (EXISTING)
 - 11. RAIL TRACK (IN STAGE-II)
 - 12. SPACE FOR FGD (LOT-1B)
 - 13. SPACE FOR FGD (LOT-4)

9	FGD LOT -3 RENAMED AS FGD LOT-4	PUSH	KK								13.09.19
8	REVISED AS PER SITE COMMENTS	MANJU	KK								30.07.19
7	SPACE FOR FGD (LOT-3) UPDATED BASED ON SITE INPUTS	MANJU	KK								26.06.19
6	SPACE FOR FGD (LOT-3) UPDATED BASED ON INPUTS FROM PE-MECH.	MANJU	AA		AK/AD/BS						27.11.18
5	SPACE FOR FGD (LOT-3) MARKED BASED ON INPUTS FROM PE-MECH.										28.08.18
4	SPACE FOR FGD REVISED	MANJU									30.04.18
3	SPACE FOR FGD MARKED	MANJU									10.01.18
2	LAYOUT GENERALLY UPDATED.	Prayag	AP	RB	AG	AK	SMK	--	DM	SR	09.09.08
1	FOR TENDER PURPOSE ONLY.	Prayag	AP	RB	AG	--	RB	--	--	AK	20.12.07
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ES	APPD	DATE
C L E A R E D B Y											

FOR TENDER PURPOSE ONLY

**NTPC Limited**
ENGINEERING DIVISION
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT
RIHAND SUPER THERMAL POWER PROJECT

TITLE
GENERAL LAYOUT PLAN

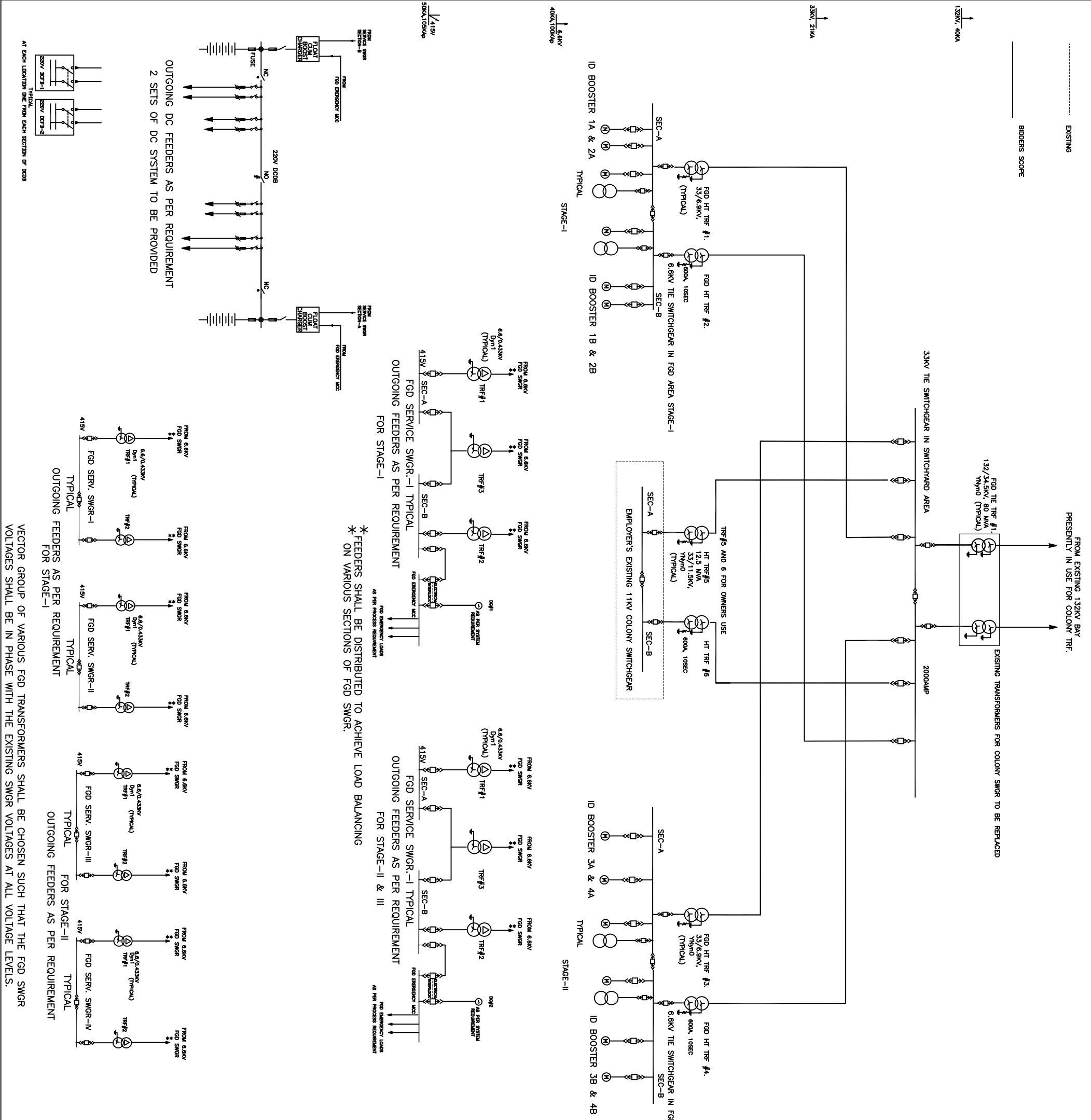
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DRG. NO.
1240-999-POC-F-001

REV. NO.
9

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- NUMBER OF MOTORS/FEEDERS SHOWN IN THE STD IS TYPICAL AND FEEDING ARRANGEMENT SHOWN AT VARIOUS LOAD CENTERS IS INDICATIVE IN NATURE SHOWING THE FUNCTIONAL REQUIREMENTS.
- BIDDER SHALL PROVIDE MINIMUM 2 NOS. DC SYSTEM OF ADEQUATE CAPACITY FOR MEETING DC LOADS IN FGD AREA.
- TWO NUMBER DG SET FOR ENTIRE FGD PLANT SHALL BE PROVIDED BY THE BIDDER FOR MEETING THE EMERGENCY PROCESS LOADS ENVISAGED FOR FGD PLANT.
- ALL BATTERY CHARGERS SHALL HAVE 2 INPUT SUPPLIES ALONG WITH SUITABLE AUTOMATIC CHANGEOVER BETWEEN THE SOURCES.
- 6.6/0.433KV SERVICE TRF SHALL BE OUTDOOR OIL FILLED OR INDOOR DRY TYPE.
- SPARES SHALL BE PROVIDED IN HT/LT SWGR. AS PER REQUIREMENTS OF TECHNICAL SPECIFICATIONS.

FOR TENDER PURPOSE ONLY		PROJECT		TITLE	
		BULK FGD LOT-IV		ELECTRICAL SINGLE LINE DIAGRAM FOR FGD PACKAGE	
		SINGRAULI STPP-I & II			
		DRAWN (DESIGN CHNG APPD)		SCALE	
		SIZE		NTS	
		REV. DATE		REV. NO.	
		NO.		C	

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
1.	Part-B	SUB-SECTION-I-M1 (FGD)	03 of 51	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.	Bidder is requested to comply the specification requirement
2.	Part-B	SUB-SECTION-I-M1 (FGD)	14 of 51	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.	Bidder is quoting a wrong reference. Specification has already been revised. Bidder is requested to refer the specification.
3.	Part-B	SUB-SECTION-I-M1	15 of 51	5.02.00	The contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry	Deviation: As per our FGD design, under normal FGD operation, the jet Air Sparger (JAS) works to keep the slurry in	Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 1 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
		(FGD)			settlement in the absorber tank in case of one agitator under breakdown (n-total no. of working agitators).	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 numbers of Agitators. However, to meet tender requirement, one spare will be provided as a ware house spare.	
4.	Part-B	SUB-SECTION-I-M1 (FGD)	33 of 51	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 handling slurry shall be provided with FRP material. FRP pipes are highly corrosive & abrasion resistant material and widely used for slurry application. Since we are using spray headers inside Absorber made up of FRP. Requesting customer to allow all pipes handling slurry with FRP option also	Bidder is requested to comply the specification requirement
5.	Part-B	SUB-SECTION-I-M1 (FGD)	26 of 51	7.04.01 SI 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 .	Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 2 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
6.	Part-B	SUB-SECTION-I-M1 (FGD)	32 of 51	7.08.04	Slurry tanks: Replaceable Chlorobutyl/ Bromobutyl rubber lining of minimum 4 mm thickness	Clarification: In addition to rubber lining rubber, bidder requesting customer to allow the vinyl ester based flake glass lining option also inside the slurry tank. Glass flake lining is widely used in FGD plants. Kindly accept.	Bidder is requested to comply the specification requirement
7.	Part-A	SUB-SECTION-V	2 of 23	5.00.00	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT	In tender specification, it is mentioned that the auxiliary power consumption for common system viz. Wet Ball Mill, Vacuum Filter system shall be divided by number of units in the project. Example: In Farakka Stage-I (3x200 MW), the limestone requirement is 10100 kg/hr whereas in Farakka Stage-II & III (3x500MW) the limestone consumption is 7900 Kg/hr per unit. In order to obtain unit auxiliary power, the common system APC cannot be divided by number of units, since limestone consumption is different for 3x200 MW absorber & 500 MW absorber. Hence bidder request customer to furnish the factor to be	For calculating the APC for common station auxiliaries Bidder is requested to refer the note : 1 of Clause 5.00.00 of SUB-SECTION-V of part-A. Further, APC calculation for common system viz. Wet Ball Mill, Vacuum Filter system etc and Transformer losses wherever it is indicated "divided by the number of units", following calculation methodology shall be
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 3 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
						considered for arriving unit auxiliary power for common system i.e. Wet Ball Mill, Vacuum Filter system etc.	followed : For example, In Farakka Project, Stage-I consists of (3x200 MW) and Farakka Stage-II & III consists of (3x500MW). Total MW capacity of Farakka projects is 2100 MW. Unit auxiliary power consumption for common system, for combined unit (3 X 200 MW) shall be $= (\text{Total APC for the project} / 2100 \text{ MW}) * 600 \text{ MW}$ Where 600 MW is the unit load, of combined unit (3 x 200 MW) where common absorber has been specified. Unit auxiliary power consumption for common system, for single unit (500 MW) shall be
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 4 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
							= (Total APC for the project / 2100 MW) * 500 MW Where 500 MW is the unit load of single unit (500 MW). Transfer losses for Unit auxiliary power consumption for common system, for combined unit (3 X 200 MW) shall be (TLU) = Losses of the transformers supplied by bidder based on works test reports (TL) / 2100 MW) * 600 MW Where 600 MW is the unit load of combined unit (3 x 200 MW) where common absorber has been specified. Transfer losses for Unit auxiliary power consumption for common system for single unit
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 5 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
							(500 MW) shall be (TLU) = Losses of the transformers supplied by bidder based on works test reports (TL) / 2100 MW) * 500 MW Where 500 MW is the unit load, of single unit (500 MW). Further, for unit load definition Bidder is requested to refer the clause no : 4.00.00 of SUB-SECTION-III-A1 of Part-A.
8.	Part-B	SUB-SECTION-IV Civil Works	32 of 67	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.	Deviation: Since, the project is being constructed in existing plant, structures like duct and pipe rack are to be routed near to the existing building and structures. Hence it is requested that welding connections may be permitted for these structures in view that the modification of these structures can be done at site which may be arise	Bidder is requested to comply to Technical Specification
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 6 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
						due to unforeseen obstructions (both above and below grounds) Kindly Accept.	
9.	SECTION- VI / PART -B	I-M3 COMPRESSOR 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 the bidder for NTPC and other customers. Please accept.	Bidder to comply with specification requirement. However, any superior Material may be accepted as per manufacturer proven design practice.
10.	SECTION- VI / PART -B	I-M3 COMPRESSOR SYSTEM	2 OF 6	4.00.00	Intercooler, After cooler & Oil coolers (For Screw).		
11.	SECTION- VI / PART -B	I-M3 COMPRESSOR 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 understanding is correct
12.	SECTION- ION-	I-M3 COM	5 OF 6	9.02.01	Each compressor shall be in the control panel to operate either in	Bidder understands that Centrifugal type air compressors are not	Bidder's understanding is correct.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 7 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	VI / PART -B	PRE SSE D AIR SYST EM			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	applicable for such smaller capacity machines. Please confirm.	
13.	SECTION- VI / PART -A	III-A2 AIR CON DITIO NING , VENT ILATI ON SYST EM & COM PRE SSE D AIR SYST EM	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.....	NTPC is requested 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. Please confirm, as bidder have considered common piping network for IA & SA application.	Bidder to refer tender drawing 0011-109-POM-A-006 "Schematic drawing of compressed air system" in this regard.
14.	SECTION- VI /	VI FUN CTIO	23 OF 25	5.00.00 (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	Duty point shall be 1.0. Bidder to comply with specification
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 8 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	PART -A	NAL GUA RAN TEES & LIQUI DITY DAM AGE S				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. We request NTPC to specify duty point for air compressors.	requirement.
15.	Section – VI, PART -A	Sub-Section III- Scope of Supply and services.	Page 5 of 6	1.11.00	Existing pipe /cable trestle, conveyors etc. passing through the proposed FGD area shall retained and FGD layout shall be prepared accordingly	Bidder understands that pipe racks/pedestal need to be constructed in new area for FGD requirement. However, existing pipe racks/pedestal can be used for routing pipes/cables related to FGD system wherever need arises. Kindly confirm.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with technical Specification.
16.	Section – VI, PART -A	Sub-Section IV- Terminal points and	Page 1 and 2 of 3	1.03.00	Terminal point for Process Water: Farakka STPP ST-III: Shall be tapped off suitably from the existing blow down header available near FGD area of of stage III.	Blowdown header is not appearing near proposed FGD areas in available PLOT PLAN. Hence kindly furnish exact terminal point (TP) for process water tapings.	Bidder to obtain required details to from site visit. However, Terminal point location shall be as per Sub-Section-IV/Part-A/Section-VI of Technical specification.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 9 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
		exclusion					
17.	Section – VI, PART -A	Sub-Section IV-Terminal points and exclusion	Page 1 and 2 of 3	1.03.00	Terminal point for Process Water: Farakka Stage II :shall be tap off suitably from service water tank of Farakka STPP ST-II.	Location of service water tank is not available in plot plan. Hence kindly furnish the location of service water tank.	Tentative location of the service water tank is 1010 S/1135 E.
18.	SECTION – VI/ PART -A	SUB-SECTION-V	PAGE 10 OF 23	CLAUSE NO: 3.00.00 C	Chimney Height (m) Single Flue 225 M	For 500MW Projects (Farakka-II & III), specification has asked for Chimney Height of 150M (Single Flue) and for Farakka-I 3X200MW (600MW) Project, specification has asked for Chimney Height of 225 M (Combined Single Flue). As the Power Output & Gas flows are comparable for Farakka-I Project and Farakka-II & III projects and further as per latest MoEF guidelines, the required chimney height for Farakka-I is much less than 225 m, Customer is requested to review the chimney height.	MOEF norms are different for 200/210 MW and 500 MW. Applicable table outlet SO2 emission is higher in 200/210 MW as compare to 500 MW unit. Because of higher applicable outlet SO2 emission combined 200/210 MW chimney height is more as compare to single 500 MW unit
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 10 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
19.	VI/C GENERAL TECHNICAL REQUIREMENTS		5 of 83	7.02.00	It has been indicated that lifting devices to be provided for weight excess of 500 kg but demarcation criteria has not been indicated for electric hoist & manual hoist.	We propose that upto 2 tonnes capacity, manual hoist shall be provided. Electric hoist shall be provided for capacity more than 2 tonnes &/or with lift more than 10 m. Above is in line with clause 4.09.00, part-A, page 10 of 12, section VI, sub section III-A5, LIMESTONE & GYPSUM HANDLING PLANT. Kindly accept the same.	Bidder to note that for FGD system other than Limestone and gypsum handling plant, the specification clause referred to be followed
20.	GENERAL				Technical requirements not indicated for electric hoists in air compressor house, ECW pump motor	We propose that electric hoists shall be class 2 duty as per IS 3938. Hoisting speed- 3-5 m/min Travelling speed- 10-15 m/min. Kindly accept the same.	Bidder is requested to refer the SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) chapter for Hoist specification
21.	SECTION-VI, PART-B	SUB SECTION: I-M5 EQUIPMENT COO	15 OF 15	Annexure-II	Maximum Auxiliary (Secondary) water available for Farakka stage I, II & III is 160, 265 & 125 m3/hr respectively.	Bidder Understands that the mentioned clarified water is only for ACW system and process water required for FGD System. Water required for Gypsum wash and HVAC make-up shall be in addition to this. Bidder shall draw total clarified water (160/265/125 + gypsum wash water +	Bidder is requested to refer the amendment in this regard.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 11 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
		LING WATER SYSTEM				HVAC make-up water) for Farakka stage I, II & III respectively. NTPC to confirm.	
22.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	5 OF 10	3.01.01 (a)	Cold water shall be tapped from existing clarified water tank of FARAKKA STPP ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Bidder understands that existing clarified water tank of Farakka Stage-I is above ground tank and flooded / positive suction shall be available (at customer Terminal point) for Horizontal centrifugal pumps (3x100%) to be provided by bidder. NTPC to confirm.	Bidder is requested to refer the amendment in this regard.
23.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COO	6 OF 10	3.01.02 (a)	Cold water shall be tapped from existing service water tank of FARAKKA STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Bidder understands that existing Service water tank of farakka Stage-II is aboveground tank and flooded / positive suction shall be available (at customer Terminal point) for Horizontal centrifugal pumps (3x100%) to be provided by bidder. NTPC to confirm.	Bidder is requested to refer the amendment in this regard.
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		LING WATER SYSTEM					
24.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	5 OF 10	3.01.01 (h)	One FGD clarified water tank.	Details (MOC etc.) & Capacity of FGD clarified water tank (to be provided by bidder) are not available in specification. Please provide the Tank capacity & other details.	Bidder is requested to refer the amendment in this regard.
25.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COO	6 OF 10	3.01.02 (h)	One FGD clarified water tank.	Details (MOC etc.) & Capacity of FGD clarified water tank (to be provided by bidder) are not available in specification. Please provide the Tank capacity & other details.	Bidder is requested to refer the amendment in this regard.
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		LING WATER SYSTEM					
26.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1 & 2 of 3	1.03.00	For Farakka Stage-III, Process water shall be tap off suitably from the existing blow down header available near FGD area of Farakka STPP ST-III.	Please inform the Pressure available at Terminal point & TP Elevation from the existing CW blow down header of stage III.	Bidder is requested to refer the amendment in this regard.
27.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS &	1 & 2 of 3	1.03.00	For Farakka Stage-III, Gypsum wash water shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.	Please inform the Pressure available at Terminal point & TP Elevation from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.	Bidder is requested to refer the amendment in this regard.
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		EXCLUSIONS					
28.	VI/ A	III-C	1 of 21	1.01.00 (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	We understand the tender is for FGD package for Lot 4 projects. NTPC may please clarify applicability of RO based desalination plant and water treatment plant for Vallur and simhadri projects (Not part of Lot 4) respectively.	Bidder's understanding is correct. RO based desalination plant and water treatment plant for Vallur and simhadri projects is not applicable for FGD LOT-4 package. Please refer amendment in this regard.
29.	VI/ A	III-C	2 of 21	1.01.00 (g)	Scope defined in PART-A read in conjunction with PART-B has to be provided for each station under LOT-2 package.	We presume the package is Lot 4 and not lot 2. NTPC may please clarify.	Bidder's understanding is correct. Please refer amendment in this regard.
30.	VI/ A	III-C	4 of 21	2.01.00	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	We understand that wireless link is not applicable for FGD package. NTPC may please clarify	Bidder's understanding is correct.
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31.	VI/ A	III-C	5 of 21	2.02.01	Quoted Price. 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.	We understand that the operation from unit control room shall be through bidder remote work station only. NTPC may please clarify. Further furniture and UPS power supply required for the same shall be by employer. Please clarify.	a) Bidder's understanding correct regarding operation of FGD system from unit control room through bidder's remote work station. b) Furniture required for placing [] above [] remote workstation shall be in bidder's scope. Pl. refer clause, 13.00.00, Part-A sub [] sec-III C [] of specification for clarity. c) Bidder to refer clause 2.04.02, Part-A, Sub sec IIIC wherein it is clarified that 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
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							in bidder's scope of supply.
32.	VI/ A	III-C	13 of 21	3.03.01 (Note 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.	We understand NSPCL Rourkela (1x250MW) project is not part of Lot 4 package. NTPC may please clarify.	Bidder's understanding is correct. NSPCL Rourkela (1x250MW) project is not part of Lot 4 package. Please refer amendment in this regard.
33.	VI/ B	III-C2	35 of 40	13.02.01	Single Input /Dual Input Temperature transmitter	Temperature multiplexer shall be used for profibus temperature measurements. NTPC may please clarify.	Bidder's understanding is not correct. As per specification Single Input /Dual Input Temperature transmitter are acceptable. Accordingly specification requirements to be complied.
34.	VI/A	III-A1	4 of 12	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	Customer is requested to accept Multi stage type Oxidation Blower with external gearbox .	Bidder is requested to comply the specification requirement
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35.	TECHNICAL SPECIFICATION SECTION - VI, PART-B BIDDOC NO : CS-0011-109(4)-9	SUB SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	6 OF 8	2.08.00	to the absorber reaction tank. Diesel Generating set(s) shall be provided as per system requirement for safe shut down of the FGD system/plant under emergency conditions and in case of total power failure. DG set(s) shall be capable of meeting 100 % of essential load requirements of FGD System including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop.	Please clarify DG loading before starting of the largest motor. Clause 2.08.00 and clause 4.10.00 is not matching.	Bidder is requested to refer the amendment in this regard
36.	TECHNICAL SPECIFICATION	SUB SECTION-II-E11 DIESEL	3 of 17	4.10.00	The DG set shall be capable of starting largest size of emergency 415 V drive (motor) having starting KVA/rated KW ratio of 8 (higher if starting current is more than 8) and starting power factor of 0.2 with	Please clarify DG loading before starting of the largest motor. Clause 2.08.00 and clause 4.10.00 is not matching.	Bidder is requested to refer the amendment in this regard
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	N SECT ION- VI, PAR T-B BID DOC NO : CS- CS- 0011- 109(4) -9	GEN ERA TOR S			terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating.		
37.	TEC HNIC AL SPE CIFIC ATIO N SECT ION – VI, PAR T-A	SUB- SECT ION- VII MAN DAT ORY SPA RES	PAGE 59 OF 63	1.08.00	Mandatory spares: Diesel Generator 10. Generator Bearing sheets 11. Rotor Pole coil 36. Resistor for Diesel generator 37. Element lube oil bypass filters 39. Plate corrosion resistor for Diesel engines 54. Starting air motor	10. Not applicable. 11. Not applicable 36. Not applicable 37. Not applicable 39. Not applicable 54. Not applicable	Technical specification is clear and bidder to comply Technical Specification.
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	BID DOC. NO.: CS-0011-109(4)-9						
38.	VI/B	I-M6	2 OF 74	2.3.0	CEMA/IS:11592	Please clarify which standard shall be used for power calculation	Bidder to follow the stipulation CEMA-5/Latest edition of CEMA/ IS:11592
39.	VI/B	I-M6	29 OF 74	2.2.0	Idler	Please specify bearing life	Bearing life shall be as per CEMA or equivalent standard subjected to minimum bearing life L10 > 30000 Hrs.
40.	VI/B	I-M6	30 OF 74	2.6.0	Pulley	Please specify bearing life	Bearing life shall be as per International / Indian proven standard.
41.	VI/B	I-M6	30 OF 74	1.1.0	DATASHEET- LIMESTONE CRUSHER	Please specify bearing life	Bearing life shall be standard in references as per technical specifications subjected to minimum bearing life B10 > 40000 Hrs.
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42.	VI/B	I-M6	2 OF 74	3.3.0	A passenger cum goods elevator of capacity 1088Kg shall be provided in limestone crusher	Please specify the type of Elevator. Whether it shall be rope & pulley type or Rack & Pinion	Bidder to follow the stipulation of technical Specification. Bidder to provide rope and sheave type conventional enclosure type passenger cum goods Elevator of capacity min. 1088 kg as per IS:14665.
43.	VI/A	III-A5	6 OF 12	3.02.00	One number of covered storage shed for gypsum. The minimum size of storage shed is indicated in the flow diagram to store gypsum equivalent to gypsum generation of minimum 7 days at Design point	Bidder requests customer to furnish flow diagram for gypsum handling system & limestone handling system as same are not available along with tender specifications.	Bidder to note that generalized flow diagram for LHP/GHP system is not provided by NTPC. Project specific flow diagram to be developed by bidder.
44.	VI/A	III-A5	2 OF 12	4.18.00	Surface Feeder	Maximum angle of surface feeder shall be 23 deg. Kindly confirm.	Maximum angle of surface feeder shall be 19 deg.
45.	VI/B	I-M6	2 OF 74	3.3.0	A passenger cum goods elevator	Please confirm, whether Machine room of passenger cum good elevators requires Air Conditioning.	Bidder to note that Machine room of passenger cum good elevators requires Air Conditioning.
46.	VI/A	III-A5	1 OF 12	1.02.01	Layout	Please furnish AutoCAD copy of Plot plan.	Bidder is requested to refer the Tender pdf drawing for this purpose.
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47.	VI/A	III-A5	10 OF 12	4.11.00	Belting and Pulleys for 1200 TPH	Bidder understands that Limestone will be received to power plant through road by trucks, so the clause 4.11.00 is not applicable. Please Confirm.	Belting and pulley for 1200TPH is not applicable for LOT-4 projects.
48.	VI/A	III-A5 (LHP & GHP)	4 OF 12 6 OF 12	2.01.16 3.03.00	Minimum four (4) Nos. sump pumps in limestone storage shed / Silos..... Minimum two (2) nos. sump pumps in gypsum storage shed complete with motors.....	Bidder requests customer to furnish the capacity of sump pump to be considered in limestone storage shed / Silos and gypsum storage shed area.	Bidder to refer clause number 4.13.4, SUB-SECTION-I-M6.

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49.	VI/A	III-A5 (LHP & GHP)	4 OF 12 6 OF 12	2.01.16 3.03.00	Minimum four (4) Nos. sump pumps in limestone storage shed / Silos.....individual discharge piping with fittings and valves to bottom ash slurry sump /disposal point Minimum two (2) nos. sump pumps in gypsum storage shed complete with motors..... individual discharge piping with fittings and valves up to bottom ash slurry sump /disposal point	Bidder shall consider sump pump discharge up to nearby surface drain. Please confirm. If not, then bidder requests customer to furnish sump pump discharge location distance (approx.) for pump head calculation.	Bidder to refer clause number 4.13.4, SUB-SECTION-I-M6.
50.	VI/A	III-A5 (LHP & GHP)	4 OF 12	2.01.21	suitable numbers of suspended magnets, (one no. on each conveyor feeding to Limestone bunker/silo)	We have not considered any suspended magnet (SM) before bunker feeding as we have considered Bucket Elevators for feeding limestone into bunker (day silo building) due to space constraint. However, bidder shall provide two nos. SM before limestone crusher house. Please Confirm.	Bidder to provide suspended magnets (on each conveyor feeding to Limestone Silo/Bunker).Please follow the stipulation of technical specification.

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51.	VI/A	III-A5 (LHP & GHP)	5 OF 12	2.01.23	Suitable numbers of electronic type belt scales (min. one no. on each conveyor) feeding to crusher house and conveyor feeding to lime stone lime stone day silo) for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories.	Bidder requests customer to clarify about belt weigh scale (BW) for gypsum handling system to be considered or not.	Belt weigh scale (BW) for gypsum handling system to be provided.
52.	VI/A	III-A5 (LHP & GHP)	11 OF 12 6 OF 12	4.15.00 3.04.00	Dust extraction system: Location : Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo. Complete plain water sprinkler type dust suppression system for control of fugitive dust in gypsum storage shed.....	Bidder requests customer to clarify about plain water sprinkler type dust suppression system to be considered for gypsum storage shed or dry type dust extraction system to be considered as these two clauses (4.15.00 & 3.04.00) are contradicting from each other.	Complete plain water sprinkler type dust suppression system for control of fugitive dust in gypsum storage shed. For other location dry type dust extraction system to be provided as per clause 4.15.00.
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53.	VI/A	VII MANDATORY SPARES	27 of 63	1.25.00	LIMESTONE & GYPSUM HANDLING: Mandatory Spares	Bidder shall provide spares as applicable for limestone & gypsum handling Please confirm.	Bidder is requested to comply the requirement of Technical specification.
54.	VI/A	VII MANDATORY SPARES	27 of 63	1.25.00	LIMESTONE & GYPSUM HANDLING: Mandatory Spares	Bidder shall provide spares as applicable for limestone & gypsum handling Please confirm.	Bidder is requested to comply the requirement of Technical specification.
55.	VI/A	II-A2 PROJECT INFORMATION (FST PP-I, II & III)	Plot Plan Layout	Plot Plan Layout	GLP (Limestone handling system/Gypsum handling system): 4410-999-POC-F-001	Bidder requests customer to furnish the AutoCAD drawing of latest plot plan by marking space for FGD including LHP & GHP for checking feasibility & freezing out FGD layout for Farakka STPP.	Only PDF drawing is envisaged in tender

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56.	VI/E	TENDER DRAWINGS	Flow Diagram for LHP & GHP	Flow Diagram for LHP & GHP	Flow Diagram: Limestone handling system/Gypsum handling system	Bidder requests customer to furnish flow diagrams for lime stone handling and gypsum handling plant for more clarity as the same are not available along with tender specifications.	Bidder to note that generalized flow diagram for LHP/GHP system is not Provided by NTPC. Project specific flow diagram to be developed by Bidder.
57.	VI/B	I-M6 (LHP & GHP)	3 OF 74	3.5.0	Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader.	Bidder has not considered any pay loaders/dumpers/Dozers/Trucks required for limestone & gypsum handling Please Confirm.	Bidder understanding is correct
58.	VI/B	I-M6 (LHP & GHP)	3 OF 74	4.1.1	Belt Width: 800 mm (Min) for 150 MTPH 1200 mm (Min) for 1200 MTPH	Bidder has considered conveyor rated capacity as 150MTPH as limestone will be received to power plant through road by trucks. So, Bidder has not considered 1200TPH as conveyor capacity. Please confirm.	Bidder understanding is correct

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59.	VI/B	I-M6 (LHP & GHP)	5 OF 74	4.1.6	Drive Motors: Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity.	Bidder requests customer to clarify these clauses as the same are contradicting from each other.	Drive equipment Rating: *110% of actual power at drive motor output shaft at specified design capacity
	VI/A	III-A5 (LHP & GHP)	38 OF 74 9 OF 12	- 4.08.00	DATA SHEET: DRIVE EQUIPMENT *120% of actual power at drive motor output shaft at specified design capacity Drive equipment Rating: *110% of actual power at drive motor output shaft at specified design capacity		

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60.	VI/B VI/A	I-M6 (LHP & GHP) III-A5 (LHP & GHP)	18 OF 74 4 OF 12	4.1.6 2.01.16	Sump pumps along with level switches & piping up to nearest Employer's drain (max up to 50.0 mtrs. from outside the building) shall be provided at all locations wherever natural drainage is not possible..... Minimum four (4) Nos. sump pumps in limestone storage shed / Silos.....individual discharge piping with fittings and valves to bottom ash slurry sump /disposal point	Bidder shall consider Sump pumps (locations as per specs) along with level switches & piping up to nearest Employer's drain (max up to 50.0 mtrs. from outside the building). Please Confirm.	Bidder to refer clause number 4.13.4, SUB-SECTION-I-M6.
61.	VI/B	I-M6 (LHP & GHP)	18 OF 74	4.13.5	Service water connections are to be provided in conveyor galleries and tunnels at 50 meter intervals. Adequate number of these connections shall be provided in all junction towers with minimum one no. at each floor and with minimum two (2) nos. at each floor in limestone crusher house.	Bidder request customer to furnish the location of nearest available tapping/ terminal point along with available pressure for taking tapping for service water system for limestone and gypsum handling systems.	Bidder is requested to refer the terminal point chapter.
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62.	VI/B	I-M6 (LHP & GHP)	18 OF 74	4.13.6	Potable water connections are to be provided in all junction towers, limestone crusher house, all tripper floors, and all control rooms/MCC rooms and toilets etc.....	Bidder request customer to furnish the location of nearest available tapping/ terminal point along with available pressure for taking tapping for potable water system for limestone and gypsum handling systems.	Bidder is requested to refer the terminal point chapter.
63.	VI/B	I-M6 (LHP & GHP)	25 OF 74	4.18.00	Surface Feeder/ BRU: The Box Feeder should be a robust, proven, above the ground for unloading from trucks/self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder.	As per this clause surface feeder/ box feeder/ BRU intake and onward discharge capacity is 200TPH. But as per technical specs, the limestone conveyor rated capacity is given as 150TPH. So, bidder requests customer to confirm about box feeder rated capacity & limestone conveyor rated capacity to be considered for limestone handling system.	Box feeder to be designed for 200 TPH design capacity.
64.	VI/B	I-M6 (LHP & GHP)	52 OF 74	ILMS/SM Data Sheet	(b) Location of SM: Over Conveyor (as per tender drawing)	Bidder is not able to found any flow diagrams for limestone & gypsum handling system. So, Bidder requests customer to furnish flow diagrams for lime stone handling and gypsum handling plant for identifying equipments location as the same are not available along with tender specifications.	Bidder to note that generalized flow diagram for LHP/GHP system is not provided by NTPC. Project specific flow diagram to be developed by bidder.
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65.	VI/B	I-M6 (LHP & GHP)	58 OF 74	Limestone Crusher Data Sheet	Drive arrangement: Electric motor, scoop type hydraulic coupling, gearbox	As recommended by the hammer mill OEM's, it is generally recommended to go with V-belt drive instead of scoop coupling with gear box. And the same has been accepted in NTPC previous FGD Projects. Please confirm.	V belt also accepted for motor of crusher unit only.

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66.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	2 of 74	3.1.0	A mechanized system shall be provided for unloading of limestone from trucks. The unloaded limestone shall be conveyed up to the limestone conveying stream before the limestone crusher.	Kindly clarify the type of mechanized unloading of trucks envisaged	Bidder to provide truck tippler and BRU along with accessories for mechanized unloading of limestone.

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67.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT (LHP & GHP)	2 of 74	3.3.0	In limestone crusher house, limestone from each incoming Conveyor shall pass through one (1) or two (2) numbers, as applicable, of (dedicated) Vibrating screening Feeders and one (1x100%) or two (2x50%) numbers, as applicable, of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system. Each stream shall have a set of Rod gates and Rack & Pinion Gates before Vibrating grizzly Feeders to permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream. Limestone sampling unit shall be provided to sample the limestone from either stream.	We understand crusher and screen can be either 2 x 100% or 4 x 50% to achieve 100% stand-by. Please clarify.	Bidders understanding is correct.

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68.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT (LHP & GHP)	2 of 74	3.4.0	Limestone Storage and Bunker feeding system	a. Please specify the percentage of crusher limestone over ground and % to be kept in underground hopper. Also, specify the acceptable % of dead stock which is to be dosed to the hopper using dozer. b. Also, clarify scope of supply of dozer. c. Type of dust extraction system envisages as it will be and open area with shed so bag filter based DE system will not be effective. So we propose exhaust fan with filter for shed for DE system and telescopic chute with dust collector for traveling trippers Please clarify and issue amendment. d. Max. height of Limestone stockpile allowed. e. Type of tripper 1 side chute , 2 side chute, 2 chute (one centre +one side) or 2 way chute.	1.Over ground facility to be 100% storage of lime stone and underground hoppers are to be designed for 1/3rd capacity. Refer clause 4.14.00 part-A,Subsection-III-A5 2. Supply of Dozer is not in bidders scope. 3. Dry type dust extraction system to be provided as per specification requirement. 4. Height of stock pile to be confirmed during detail Engineering. Height to be determined without compromising the total lime stone storage capacity. However, Bidder to note that further, minimum one meter peripheral clearance around stock pile and minimum 1-meter clearance from bottom of beam, to be provided for stock pile. 5. Two side tripper chute is preferred.
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69.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	11 OF 74	4.9.0	LIMESTONE CRUSHER AND VMS	Please clarify the type of hammer mill crusher as per our experience it shall be reversible for ease of maintenance.	Bidder to follow the stipulation of technical specification.

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70.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	17 OF 74	4.13.0	DUST CONTROL AND MISCELLANEOUS SYSTEM	Dust extraction system shall be common for both streams of conveyors with one set of bag filter, centrifugal fan common for both stream and accordingly capacity to be selected Or individual DE system with bag filter, centrifugal fan for each stream of conveyor. Please clarify. Also, clarify the type of dust control system for gypsum shed.	Bidder to refer clause-4.15.00 (Part-A,III A-5) along with 4.13.0 (VI-Part-B). In particular individual DE system to be provided with bag filter, centrifugal fan etc. for each stream of conveyor.

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71.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	18 OF 74	4.13.2	Service Water and cooling Water System	Cooling water is not envisaged as air cooled scoop coupling will be provided , Please clarify .	In case of air cooled scoop coupling , cooling water is not required.

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72.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	19 of 74	4.13.19	Dust extraction system for Limestone Handling area:	Clarification is required for type of dust extraction system envisages, as it will be and open area with shed so bag filter based DE system will not be effective. So we propose exhaust fan with filter for shed for DE system and telescopic chute with dust collector for traveling trippers Please clarify and issue amendment.	Bidder's scheme is not clear. Bidder to follow the stipulation of technical specification.
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73.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	25 of 74	4.18.0	BOX FEEDER OR BULK MATERIAL RECEIVING UNIT OR TRUCK UNLOADING SYSTEM OR SURFACE FEEDER:	Please clarify capacity of box feeder as downstream conveyors are designed for 150TPH. Whether any temporary storage hopper to be considered for box feeder, if yes Please furnished capacity. Also, specify truck tippler capacity.	- Box feeder to be designed for design capacity of 200TPH. - Minimum temporary storage capacity considered for box feeder is 40 TPH.

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74.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	42 of 74	1.2.0	DATA SHEET: DUST CONTROL & MISCELLANEOUS SYSTEM Miscellaneous systems Service water system, Potable water system, Cooling water system, sump pump and DE system pumps	No pumps are envisaged as DE is dry type.	DE system for lime stone handling system to be dry type. However, please note for gypsum shed plain water sprinkler system to be provided.

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75.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	48 of 74	1.1.0	DATA SHEET: VENTILATION SYSTEM	Is any ventilation system envisaged for bay where traveling tipper for limestone and gypsum are moving.	Ventilation system envisaged for bay where traveling tipper for limestone and gypsum are moving. Refer clause 2.01.17, Part-A,III A-5 in this regard
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76.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	61 of 74	4.03.01	System Operation (a.) Lime flow path selection shall be done from CRT/Keyboard to select any one of the following conveying paths. a. Track hopper to Limestone storage shed b. Wagon Tippler to Limestone storage shed c. Limestone storage shed to Limestone bunker d. Combination of above	Please clarify track hopper / wagon tippler where it is.	Rail loading facility for lime and gypsum is not applicable to LOT-4 projects.

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77.	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	73 of 74	4.23.00	Crushed Lime Stone Storage Silo: The crushed lime stone storage silo shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete conical portion to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 (part 1 of 3). Silo is to be provided with discharge at the bottom with vibratory feeders. Each silo to be fitted with steel legs, fences, side ladders and operating platforms. Each silo is required to be equipped with following: level switches, dust collectors with bag filters and dust rapping mechanism, air flow pads for aeration/air blast of material, vent fan with filters, manual, pneumatic or electrically operated valve as per proven design criterion of silos and pressure relief valve settled at predetermined relief pressure to avoid pressuring of silo at various operating conditions. Capacity as indicated are minimum. Each Silo is to be designed for 7 days retaining capacity of material with adequate air space with maximum capacity limitation up to 2000MT .	This point is in contradiction with cl. 3.4.0 in page 2 of 74. So, please clarify the type of storage system for crushed limestone desired - Silo or Hopper with paddle feeders.	It is up to the bidder to choose between lime stone storage silo or covered lime stone storage shed. In case of limestone storage shed underground hoppers with paddle feeders are to be facilitated.

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78.	SUB SECTION-II-A4 PROJECT INFORMATION (SINGRAULI I&II (5X200 & 2X500MW))	-	--	-	PLOT PLAN DRG NO. 1150-999-POC-F-001 REV 2	Space is not sufficient for limestone handling and gypsum handling system. Discussion required.	Bidder to plan FGD facilities within allocated spaces only which have been earmarked in Tender GLP.
79.	SECTION-VI, PART-B	II-E1	2 of 8	2.01.00	Transformers	We have considered dry type (indoor) transformers. Pl. confirm.	Bidder may refer Note-10 of Tender SLD.

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80.	SECTION-VI, PART -B	I-M6	13 of 74	4.9.5	VMS	We have considered Vibration Monitoring system only for Crushers not for any HT Motors of LHP&GHP. Pl. confirm.	VMS for HT motors not envisaged.
81.	SECTION-VI, PART -B	II-E15	4 of 18	3.03.00	DC Lighting	Kindly provide us the locations of LHP&GHP areas for providing Emergency DC Lighting.	The DC lighting shall be provided in strategic location for safe exit, operation of equipment etc. and shall be decided during detail engineering.
82.	SECTION-VI, PART -B	I-M6	8 of 74	4.4.3	Flap Gate	Kindly clarify the location of Starters for LHP&GHP Flap gates, RPG Gates etc. whether to consider with integral starter or starter to be located in MCC.	Position of starter to be confirmed during detail engineering
83.	SECTION-VI, PART -B	III-C5	4 of 23	2.03.00	HMI	We understand that, EWS/OWS/Printers are for total FGD System and to be located in Main FGD Control room. No separate workstations, printers etc. considered for LHP & GHP Systems.	Bidder to refer Appendix 1 to PART-A wherein Operating Devices & their locations is specified. Bidder to comply with the specification requirement.
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84.	SECTION-VI, PART -B	III-C5	17 of 23	8.03.00	System cabinets	We have not considered any Control cabinets/Desks/ECP/MIMIC Panels for LHP & GHP Systems.	It is envisaged to operate and control complete FGD system from FGD DDCMIS. Bidder to refer clause 2.02.01, PART-A, Sub Sec IIIC regarding the process blocks envisaged in FGD DDCMIS system.
85.	SECTION-VI, PART -B	I-M6	63 of 74	4.06.00 (i)	Conveyor system	Kindly provide us the installation distances of each Pull chord Switch along the Conveyor.	Bidder is requested to comply the specification requirement.
86.	SECTION-VI, PART -B	I-M6	63 of 74	4.06.00 (d)	Conveyor system	Kindly provide us the installation distances of each Belt Sway Switch along the Conveyor.	Bidder is requested to comply the specification requirement.
87.	SECTION-VI, PART -B	I-M6	63 of 74	4.06.00	Conveyor system	As a standard practice, One Number Belt Monitoring System Panel is considered for all LHP & GHP Conveyors of FGD System.	Bidder is requested to comply the specification requirement.
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88.	SECTION-VI, PART -B	I-M6	60 of 74	4.01.00 (F)	LSU - Overall operation of LSU equipment of Lime Handling Plant shall be controlled from the main FGD control room through FGD DDCMIS being provided by the Contractor.	The above two clauses mentioned in Sl. Nos (10) and (11) are contradicting each other. Kindly clarify.	Bidder is requested to comply the specification requirement.
	SECTION-VI, PART -B	I-M6	70 of 74	4.12.00	Lime Sampling Unit shall be controlled through PLC as per standard and proven practices		Lime sampling Unit shall be PLC controlled and interface shall be provided for FGD DDCMIS for monitoring and control.
89.	IIA-5	Project Information	16 of 32	7.07.00	Soil Data	Kindly provide Soil Data for NTPC Rihand project	Bidder is requested to Refer clause 7.00.00 of Project Information of Part-A of technical specification.
90.	ANNEXURE –B OF PROJECT INFORMATION OF ALL TENDERS				Wind Load	As per IS:875, Part-3 2015, Value of K4 is being considered as 1 for all the five projects. Please confirm.	Cyclonic factor k4 shall be applicable as per the provisions of IS 875 Part-3 (2015)

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91.	4- Part B	Civil	3 of 67	3.01A.00	Limestone Storage Silo	Please confirm the paving required for Limestone Storage Silo	Area has to be paved as per details furnished at clause No. 7 of Technical Specification, Part B Civil Works.
92.	SECTION- VI / PART -B	I-M3 COMPRESSOR 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 BHEL for NTPC and other customers. Please accept.	Bidder to comply with specification requirement. However, any superior Material may be accepted as per manufacturer proven design practice.
93.	SECTION- VI / PART -B	I-M3 COMPRESSOR SYSTEM	2 OF 6	4.00.00	Intercooler, Aftercooler & Oil coolers (For Screw)		
94.	SECTION- VI / PART -B	I-M3 COMPRESSOR 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. NTPC to confirm.	
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95.	SECTION- VI / PART -B	I-M3 COMPRESSOR D 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. NTPC to confirm.	Bidder's understanding is correct.
96.	SECTION- VI / PART -A	III-A2 AIR CONDITIONING , VENTILATION SYSTEM & COMPRESSOR D 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.....	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. Please confirm, as bidder have considered common piping network for IA & SA application.	Bidder to refer tender drawing 0011-109-POM-A-006 "Schematic drawing of compressed air system" in this regard.
97.	SECTION	VI	23 OF	5.00.00	Total power consumption at motor	Bidder request NTPC to specify the	Duty point shall be 1.0.
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	ION-VI / PART -A	FUNCTIO NAL GUA RAN TEES & LIQUI DITY DAM AGE S	25	(xxiii)	input terminal at rated duty of air compressor.....	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. We request NTPC to specify duty point for air compressors.	Bidder to comply with specification requirement.
98.	SECTION – VI, PART -A	SUB-SECTION-II-A5 Project Information for Rihand-1 (2x500 MW)	2 of 32	1.04.00 (Water Data)	Process water quality is CW blowdown quality based on COC in Table-4.	The quality of process water as indicated in these two clauses is different. Bidder understands that water required for process water, gypsum washing and HVAC make-up if clarified water and shall be drawn from customer's existing Clarified water Tank of Rihand Stage-II. NTPC to confirm.	Bidder to comply technical specification
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	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	For Rihand-I, process water and gypsum wash water shall be tap off suitably from clarified water tank of Rihandstage-II.		Bidder is requested to refer the Amendment to In this regard.
99.	SECTION-VI, PART -B	SUB SECTION: I-M5 EQUIPMENT COOLING WATER SYSTEM	15 OF 15	Annexure-II	Maximum Auxiliary (Secondary) water available for Rihand-I FGD Project is :- 265 m3/hr.	Bidder Understands that the 265 m3/hr clarified water is only for ACW system and process water required for FGD System. Water required for Gypsum wash and HVAC make-up shall be in addition to this. Bidder shall draw total clarified water (265 + gypsum wash water + HVAC make-up water) from clarified water tank of Rihand Stage-II. NTPC to confirm.	Bidder is requested to refer the amendment in this regard.
100.	SECTION	SUB	10 OF	1.01.01	Cold water shall be tapped from	Bidder understands that existing	Bidder is requested to
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	ION-VI, PART -A	SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	10		existing clarified water tank of RIHAND STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	clarified water tank of Rihand-II is aboveground tank and flooded / positive suction shall be available (at customer Terminal point) for Horizontal centrifugal pumps (3x100%) to be provided by bidder. NTPC to confirm.	refer the Amendment to In this regard.
101.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	10 OF 10	1.01.01 (h)	One FGD clarified water tank.	Details (MOC etc.) & Capacity of FGD clarified water tank (to be provided by bidder) are not available in specification. Please provide the Tank capacity & other details.	Bidder is requested to refer the Amendment to In this regard.
102.	VI/C		5 of 83	7.02.00	It has been indicated that lifting	We propose that up to 2 tons	Bidder to note that for
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					devices to be provided for weight excess of 500 kg but demarcation criteria has not been indicated for electric hoist & manual hoist.	capacity, manual hoist shall be provided. Electric hoist shall be provided for capacity more than 2 tons &/or with lift more than 10 m. Above is in line with clause 4.09.00, part-A, page 10 of 12, section VI, sub section III-A5, LIME STONE & GYPSUM HANDLING PLANT. Kindly accept the same.	FGD system other than Limestone and gypsum handling plant, the specification clause referred to be followed
103.	General				Technical requirements not indicated for electric hoists in air compressor house, ECW pump motor	We propose that electric hoists shall be class 2 duty as per IS 3938. Hoisting speed- 3-5 m/min Travelling speed- 10-15 m/min. Kindly accept the same.	Bidder is requested to refer the SUB-SECTION-I-M6 LIME STONE AND GYPSUM HANDLING PLANT(LHP & GHP) chapter for Hoist specification
104.	Section – VI, PART -A	Sub-Section III-A1	Page 8 of 12	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.	Bidder understands that pipe racks/pedestal need to be constructed in new area for FGD requirement. However, existing pipe racks/pedestal can be used for routing pipes/cables related to FGD system wherever need arises. Kindly confirm.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with technical Specification.
105.	SECTION –				FGD TIE TRF#1 & FGD TIE TRF#2	a) Provide layout & location of existing 12.5 MVA transformer which is to be	a) Bidder may refer GLP. Bidder may also visit the
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	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	VI/ PART – E	Electrical single line diagram for FGD Package- RIHAND STPP-I				replaced with FGD TIE Transformer#1. b) Bidder will provide FGD TIE transformer#1 &2 as per the rating mentioned in SLD.	project in order to get itself acquainted with existing electrical plant/facilities etc. b) Confirmed
106.	SECTION – VI/ PART – E	Electrical single line diagram for FGD Package- RIHAND STPP-I			HT trf 5 & 6	a) Bidder will provide HT trf 5 as per the rating mentioned in SLD. a) Kindly furnish location of 11 kV existing switchgear. c) NTPC to check & confirm neutral earthing of HT transformer 5 since same is solidly grounded & hence no NGR shall be applicable.	a) Noted b) Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. c) Bidder to refer amendment in this regard.
107.	SECTION – VI/ PART – E	Electrical single line diagram for FGD Package- RIHAND STPP-I				HV side of L.T. Service Transformers 11kV may also be allowed in addition to 3.3 kV.	Bidder to comply with Technical specification requirement.
108.	SECTION – VI/ PART – E	Electrical single line diagram for FGD Package- RIHAND STPP-I			%age impedance of LT transformer	Please note that STAR-2 rating with mentioned impedance is technically not feasible for oil filled service transformers. Hence NTPC is requested to review & clarify.	Bidder to comply with Technical specification requirement.
109.					Additional point	Kindly clarify dismantelling scope of	Bidder to refer Clause
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	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
						existing 12.5 MVA like shifting of transformer & further storage etc.	1.17.00, Sub-Section IIIB, Part-A, Section VI of Technical specification.
110.	SECTION – VI/ PART – B	II E-1	3 of 8	2.02.00	33kV incomers from transformers shall be through suitably rated cables as specified in cl 2.05.00 of this subsection	Please confirm that bidder will have the flexibility to choose the cable or bus bar connection as per the required rating and layout constraint.	Bidder to comply with Technical specification.
111.	SECTION – VI/ PART – B	II E-1	4 of 8	2.04.00	Wherever modification of owners HT switchgear is envisaged, Contractor shall make necessary provisions for owners's HT switchgear control from owners DDCMIS/Contractor's FGD DDCMIS/ PLC (as decided during detailed engineering). Necessary control wiring for this purpose also shall be in contractor's scope	It is clarified that the modification work in customer's 11kV SWGR shall be in customer's scope and the control of these 11kV breakers from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by customer. Further, Control of Bidder's FGD Swgr 33KV/11KV/415 V from FGD DDCMIS/ PLC shall be in Bidder's Scope. Any interface of FGD DDCMIS with Customer's DDCMIS shall be in customer's scope. Please confirm.	Technical specification is clear. Bidder to comply with Technical specification requirement.
112.	SECTION –	II E-1	5 of 8	2.07.00	Minimum rating of battery: 150AH for lead acid Plante type /90 AH for Ni-	Please specify design temperature at which mentioned AH ratings are to be	Bidder to refer Clause no. 2.07.00, Sub-Section
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	VI/ PART – B				Cd High Discharge (KPH) type batteries & Nos. of cells: As per Sizing Calculations	provided.	IIE-1, Part-B, Section VI of Technical specification.
113.					PA SYSTEM	There is no specification for PA system in de-tailed technical specification Part A & B-Electrical & C-C&I System. Please confirm whether PA system is to be considered a part of FGD or not. If to be considered, please pro-vide the detailed specification for the same.	Public Address System is excluded from bidder's scope of supply.
114.	SECTION – VI/ PART – A	II A-5	8 of 32	7.00.0	Foundation system and Geotechnical data	Kindly provide soil resistivity data.	Detail data Will be provided after award of contract if available
115.	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.	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. Cutting of trees and their disposal 2. Dismantling of any existing temporary/permanent structures and clearing debris. 3.Slope protection 4. Diversion of any existing	Site clearance and minor grading as required is in bidder's scope. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY &
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						facilities/structures, nalla, etc. 5. Stacked materials/equipments, etc. if any, located at proposed FGD area shall be cleared by owner. Please confirm.	SERVICES In this regard for details scope.
116.	VI/B	IV-D	6 OF 67	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.	For the subject clauses, kindly mention clearly 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.	Type of Building structure (RCC/ Steel), if not specified in the Technical 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 67	3.15.00	Limestone Grinding System Building		Bidder is requested to refer the amendment in
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					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.		this regard.
	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
117.	VI/B	IV-D	15 OF 67	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.	Refer General Layout Plan. Road and drain drawing shall be provided after award if available.
118.	VI/B	IV-D	25 OF 67	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.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
							availability.
119.	VI/B	IV-D	35 OF 67	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 is requested to comply the specification.
120.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
121.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
122.	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.	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.	Minor grading as required is in bidder's scope.
123.	VI/A	II-A5	11 OF 32	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 IS 2911 Part-1 Section-2. Please confirm.	Bidder to comply the Technical Specification
124.	VI/A	II-A5	11 OF	7.02.02 e)	During detailed engineering, the	The maximum allowable bearing	Bidder to comply the
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			32		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-1.	pressure shall be as per the approved geotechnical report during detailed engineering. Please confirm.	Technical Specification
125.	VI/A	II-A5	17 of 32	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.	Contractor is required to carry out geotechnical investigation in this area. During detailed engineering, pile capacity shall be adopted after approval of geotechnical investigation report. However, the pile capacity shall be least of the three values i.e. as per approved geotechnical report, as per the values furnished in Technical Specification and pile capacity achieved in pile load
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							tests. 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-1.
126.	VI/A	II-A5	23 of 32	Annexure-IV	Soil data	Annexure-IV Bore log data is not available in the tender document. Please furnish the following details: 1. Bore log details 2. Electrical Resistivity Test Results. 3. Chemical analysis of ground water and sub soil	Bidder is requested to refer the clause Refer clause 7.00.00 of Project information Part A of technical specification
127.	-	-	-	-	General	Please furnish the Topographical Survey drawing showing contour and spot levels of the existing ground of	Required drawings have been provided in the tender. However, detail
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						the proposed FGD area.	drawing will be provided to bidder in case of award based on availability.
128.	VI/ A	V	9 OF 23	3.00.00 C	Chimney Height (m) Single Flue 225 M	For 500MW Project (Singrauli St-II) specification has asked for Chimney Height of 150M (Single Flue) , whereas for Singrauli St-I 3X200MW (~600MW) specification has asked for Chimney Height of 225 M (one flue combined) . Comparing the power output & gas flows for the both the projects (i.e Singrauli St-I & Singrauli St-II) and stipulated MoEF norms, this 225 m height is on much higher side. Customer is requested to revisit the clause & provide clarification/modification, if any.	MOEF norms are different for 200/210 MW and 500 MW. Applicable table outlet SO2 emission is higher in 200/210 MW as compare to 500 MW unit. Because of higher applicable outlet SO2 emission combined 200/210 MW chimney height is more as compare to single 500 MW unit
129.	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.	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. Cutting of trees and their disposal 2.Dismantling of any existing	Site clearance and minor grading as required is in bidder's scope. Further, Bidder is requested to refer the
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						temporary/permanent structures and clearing debris. 3.Slope protection 4.Diversion of any existing facilities/structures, nalla, etc. 5.Stacked materials/equipments, etc. if any, located at proposed FGD area shall be cleared by owner. Please confirm.	clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard for details scope.
130.	VI/B	IV-D	6 OF 67	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.	For the subject clauses, kindly mention clearly 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.	Type of Building structure (RCC/ Steel), if not specified in the Technical 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
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							construction and site constraints (if any).
	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
131.	VI/B	IV-D	15 OF 67	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.	Refer General Layout Plan. Road and drain drawing shall be provided after award if available.
132.	VI/B	IV-D	25 OF 67	15.00.00	The connection of sewer pipe line for the associated buildings of FGD and	Please provide the co-ordinates and invert level of owner's existing sewage	Required drawings have been provided in the
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					Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.	network, where the sewer pipe line from the proposed FGD area shall be connected.	tender. However, detail drawing will be provided to bidder in case of award based on availability.
133.	VI/B	IV-D	35 OF 67	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 is requested to comply the specification.
134.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
135.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
136.	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.	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.	Site clearance and minor grading as required is in bidder's scope.
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137.	VI/A	II-A4	12 of 31	7.02.02 e)	During detailed engineering, the allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure in rock shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-1.	The maximum allowable bearing pressure shall be as per the approved geotechnical report during detailed engineering. Please confirm.	Bidder to comply the Technical Specification
138.	VI/A	II-A4	13 OF 31	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 IS 2911 Part-1 Section-2. Please confirm.	Bidder to comply the Technical Specification
139.	VI/A	II-A4	18 of 31	7.02.02 e)	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.	Contractor is required to carry out geotechnical investigation in this area. During detailed engineering, pile capacity shall be adopted after approval of geotechnical investigation report. However, the pile capacity shall be least of the three values i.e. as per approved
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							geotechnical report, as per the values furnished in Technical Specification and pile capacity achieved in pile load tests. 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-1.
140.	VI/A	II-A4	-	Annexure-IV	Soil data	Only Bore logs and laboratory test results are furnished. Please furnish the following additional data: 1. Electrical Resistivity Test Results. 2. Chemical analysis of ground	Available data has been already furnished.
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						water and sub soil samples	
141.	-	-	-	-	General	Please furnish the Topographical Survey drawing showing contour and spot levels of the existing ground of the proposed FGD area.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
142.	SECTION – VI/ PART – E			Electrical single line diagram for FGD Package-SINGRAUL I STPP-I& II	FGD TIE TRF #1 & 2	a) Provide layout & location of existing Colony transformer which is to be replaced with FGD TIE TRF#1&2. b) HT side voltage of FGD Tie transformer shall be 132KV as mentioned in the SLD. c) MVA rating of the transformer will be considered as 80MVA only. Please confirm. d) For connection between FGD TIE TRF #1 & 2 to 33kV TIE switchgear please allow to use cable or busduct connection as per the feasibility of layout.	a) Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. b)Confirmed c)Confirmed d)Noted
143.	SECTION – VI/ PART			Electrical single line diagram for FGD	33kV TIE Switchgear	a) Please Provide location where this switchgear will be placed. b) If this switchgear need to be placed in existing building, please provide	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with
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	– E			Package-SINGRAUL I STPP-I& II		electrical equipment & cabling layout of the same along with scope of work. c) Total nos. of feeders and rating of the switchgear shall be as indicated in the drawing. Please confirm.	existing electrical plant/facilities etc.
144.	SECTION – VI/ PART – E			Electrical single line diagram for FGD Package-SINGRAUL I STPP-I& II	TRF #5 & 6 for owners use	a) The rating mentioned in drawing for Trf #5 will be considered for Trf # 6 also. Please confirm. b) Please indicate location of the transformer along with associated civil scope of work. c) Please provide detailed layout drawing of existing 11kV colony switchgear indicating location of Incomer. Based on the same Busduct/ cable connection to TRF #5 & 6 will be decided. d) We understand that modification required in the incomers only of existing 11kV colony switchgear is in bidder's scope. Please confirm. e) Please provide 132kV Switchgear control room layout.	1. Confirmed 2. Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. Bidder may further refer Clause 1.17.00, Sub-Section IIIB, Part-A of Technical Spec 3. Same shall be provided to successful Bidder after award of Contract. 4. Confirmed 5. Same shall be provided to successful Bidder after award of
145.	SECTION –			Electrical single line	33kV out going cable	Owner is requested to furnish all pipe & cable trestle layouts to establish the	Same shall be provided to successful Bidder after
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	VI/ PART – E			diagram for FGD Package-SINGRAUL I STPP-I& II		feasibility of routing of cables on existing pipe cum cable trestles.	award of Contract.
146.	SECTION – VI/ PART – E			Electrical single line diagram for FGD Package-SINGRAUL I STPP-I& II	%age impedance of LT transformer	Please note that STAR-2 rating with mentioned impedance is technically not feasible for oil filled service transformers. Hence NTPC is requested to review & clarify.	Bidder to comply with Technical specification.
147.	PART A	III B	4 OF 9	1.06.00	Control and protection of new 220kV/132KV Bays and 220/34.5kV, 132KV/34.5 FGD Tie Transformers as per the Tender SLD for FGD system. Protection system shall be provided with Numerical relays.	Pls. confirm existing Bays are 132KV as mentioned in the Tender SLD as per the FGD trf rating.	Bidder to ref to Spec. Part-A, Sub Section -IIIB, Clause No:1.05.00. For FGUTPP the existing switchyard bay is 220KV and for Rihand STPP-1 the existing switchyard bay is 132KV.
148.	PART A	III B	7 OF 9	1.11.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number.	The lighting mast shall be provided as per the requirement/area
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							lighting.
149.	PART B	II E-1	4 of 8	2.04.00	Wherever modification of owners HT switchgear is envisaged, Contractor shall make necessary provisions for owners's HT switchgear control from owners DDCMIS/Contractor's FGD DDCMIS/ PLC (as decided during detailed engineering). Necessary control wiring for this purpose also shall be in contractor's scope	It is clarified that the modification work in customer's 11kV Colony SWGR shall be in customer's scope except modification work in the incomers and the control of these 11kV breakers from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by customer. Further, Control of Bidder's FGD Swgr 33KV/6.6KV/415 V from FGD DDCMIS/ PLC shall be in Bidder's Scope. Any interface of FGD DDCMIS with Customer's DDCMIS shall be in customer's scope. Please confirm.	1. Confirmed 2. Logics and interface related to transformer protection for Colony swgr with DDCMIS & swgr as required shall be in Bidder's scope. 3. PE-C&I
150.	PART B	II E-1	5 of 8	2.07.00	Minimum rating of battery: 150AH for lead acid Plante type /90 AH for Ni-Cd High Discharge (KPH) type batteries.	Please specify design temperature at which mentioned AH ratings are to be provided.	Bidder to refer Clause no. 2.07.00, Sub-Section IIE-1, Part-B, Section VI of Technical specification.
151.					PA SYSTEM	There is no specification for PA system in de-tailed technical	Public Address System is excluded from bidder's
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						specification Part A & B-Electrical & C-C&I System. Please confirm whether PA system is to be considered a part of FGD or not. If to be considered, please provide the detailed specification for the same.	scope of supply.
152.	PART B	II-E6	12 of 27	4.04.04	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 meter.	Single core cables in trefoil formation shall be laid with a distance of 2 times the diameter of cables between trefoil center lines as per standard practice. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
153.	PART B	II-E6	12 of 27	4.04.04	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 meter.	Cable shall be clamped at every two meter or one meter as per clause 3.08.01. Please clarify	Technical specification is clear and bidder to comply Technical specification.
154.	PART B	II-E6	93 OF 100	0000-211-POE-A-030	Vertical support: 1) For 1 to 6 tier of 600mm tray -C2 channel	C1 channel shall be used upto 3 tier of 600mm tray	Technical specification is clear and bidder to comply Technical specification.
155.	PART B	II-E6	13 of 27	4.4.14(3)	Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other	It shall be complied to the extent feasible for essential drives only.	Technical specification is clear and bidder to comply Technical specification.
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					set.		
156.	PART B	II-E6	5 of 27	3.02.02(f)	Cantilever arms of 320mm, 620mm and 750mm ...with tray in position	Since only 600mm, 300mm and 150mm are to be installed as per technical specification Cl. No 3.01.03 of II-E6 of Part-B, thus Cantilever arms of 170mm for 150mm wide tray, 320mm for 300mm wide tray and 620mm for 600mm wide cable tray shall be provided as per W+20 shown in Dwg 0000-211-POE-A-030 pg 96 of 100 of 2A-Part B	Technical specification is clear and bidder to comply Technical specification.
157.	PART B	II-E7	6 of 6	4.01.03	The standard length of HT Cable shall be 1000m for all single core.....750m for 3 core cable.	Standard length for single core and 3 core cable HT power cable shall be 500/750m so as to avoid wastage. Pls accept.	Bidder is requested to refer the amendment in this regard.
158.	PART B	II E-15	4 of 18	3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here.	Illumination of only FGD area in scope are being considered	Bidder understanding is correct
159.	PART B	II E-15	9 of 18	4.0.00 (14)	In the hazardous areas like Hydrogen generation.....lighting shall be flameproof	Illumination of only FGD area in scope are being considered	Bidder understanding is correct.
160.	PART B	II E-15	11 of 18	4.07.00	Occupancy based Passive Infra-red sensors	Please mention areas where sensors are to be used. As there is no office area, conference rooms etc. in FGD scope so these sensors are	Occupancy based Passive Infra-red sensors shall be used in office area, conference
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						not being considered	rooms etc. in FGD scope area if available.
161.	PART B	II E-14	1 of 9	2.01.00	Type A fire sealing system in CER & CCR.	Since CER & CCR is not in scope of FGD area, so Type A fire sealing system is not being considered. Only Type B fire sealing system shall be provided	Please note that Type B fire sealing system shall be provided for control panels and for remaining area's Type A fire sealing shall be used.
162.	Section-VI / Part-B	Sub-Section I-M1	Page 37 of 51	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.	We understand that major piping/cable trays shall be routed on Steel trestle but kindly clarify whether piping/cable trays can be routed on pedestals in BOP area. Also clarify whether existing pipe cum cable trestle can be used for supporting the pipes.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with technical Specification.
163.	Section-VI / Part-A	Sub-Section-IV Terminal point & Exclusions	Page 2 of 3	1.03.00	PROCESS WATER i). Tap off suitably from clarified water tank of Singrauli-I for 5x200 MW Singrauli Stage-I. ii). Tap off suitably from clarified water tank of Singrauli-II for 2x500 MW Singrauli Stage-II.	As per available tender PLOT PLAN, Clarified water tank has been identified at only one location between grid 20B & 22B. Kindly clarify whether existing clarified water tank is common for both stage I & II.	Bidder is requested to refer the amendment in this regard
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164.	Vol VI/E	P&ID of ECW system for FGD system (drg no., 0011-109(3))-POM-A-004)	8 of 57	Section B5 of drawing	CLARIFIED WATER SUPPLY TO IN UNIT I & II FGD SYSTEM	We understand that clarified water supply from Existing clarified water pumps shall be provided for Singrauli Stage-I ((5 x 200 MW) + stage-II (2 x 500 MW) separately. Pl. Confirm.	Bidder is requested to refer the amendment in this regard
165.	Vol VI/E	P&ID of ECW system for FGD system (drg no.,	8 of 57	Section B5 of drawing	Clarified water supplied from clarified water tank through existing clarified water pumps.	In the PID of ECW system, it is shown that clarified water from existing clarified water pump house shall be supplied by 05 nos. existing clarified water pumps. Bidder has to take a tapping from clarified water pumps discharge header for further pumping by FGD Auxiliary (Secondary) water pumps. However in SUB SECTION: III-A4, it is mentioned that clarified	Bidder is requested to refer the amendment in this regard
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		0011-109(3)-POM-A-004)				water to be pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps by bidder. Please clarify whether bidder has to consider 3X100% pumps along with FGD clarified water tank in their scope.	
166.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	8 OF 10	4.01.01	Cold water shall be tapped from existing clarified water tank of Singrauli ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Further Details (MOC etc.) & Capacity of FGD clarified water tank (in case to be provided by bidder) are not available in specification. Please provide the Tank capacity & other details. Also please clarify whether existing clarified water tank is aboveground tank and flooded / positive suction shall be available for Horizontal centrifugal pumps (3x100%) (in case to be provided by bidder.)	Bidder is requested to refer the amendment in this regard
167.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT	9 OF 10	4.01.01 (a)	Cold water shall be tapped from existing clarified water tank of SINGRAULI STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and		Bidder is requested to refer the amendment in this regard
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		COO LING WAT ER SYST EM			necessary pipe line, valves etc.		
168.	SECT ION- VI, PART -A	SUB SECT ION: III-A4 EQUI PME NT COO LING WAT ER SYST EM	8 OF 10	4.01.01 (a)	One FGD clarified water tank.		Bidder is requested to refer the amendment in this regard
169.	SECT ION- VI, PART -A	SUB SECT ION: III-A4 EQUI PME NT	9 OF 10	4.01.01 (h)	One FGD clarified water tank.		Bidder is requested to refer the amendment in this regard
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		COOLING WATER SYSTEM					
170.	SECTION-I, PART -M5	ANNEXURE-II MAXIMUM AUXILIARY WATER AVAILABLE	15 POF 15	4.0	Maximum Auxiliary water available is 265 cubM/hr for stage-I & II each	Bidder understands that the 265 m3/hr clarified water is only for ACW system and process water required for FGD System. Water required for Gypsum wash and HVAC make-up shall be in addition to this. Bidder shall draw total clarified water (265 + gypsum wash water + HVAC make-up water) from clarified water tank of Singrauli Stage-I & II each.	Bidder is requested to refer the amendment in this regard
171.	SECTION-VI / PART -B	I-M3 COMPRESSOR 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	Bidder to comply with specification requirement. However, any superior Material may be accepted as per manufacturer proven
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172.	SECTION-VI / PART-B	I-M3 COMPRESSOR SYSTEM	2 OF 6	4.00.00	Intercooler, Aftercooler & Oil coolers (For Screw)	and other customers. Pl. accept.	design practice.
173.	SECTION-VI / PART-B	I-M3 COMPRESSOR 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. NTPC to confirm.	Bidder understanding is correct
174.	SECTION-VI / PART-B	I-M3 COMPRESSOR 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. NTPC to confirm.	Bidder's understanding is correct.
175.	SECTION-VI / PART	III-A2 AIR CONDUIT	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.....	NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate	Bidder to refer tender drawing 0011-109-POM-A-006 "Schematic drawing of compressed
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	-A	NING , VENTILATION SYSTEM & COMPRESSED AIR SYSTEM				network of Instrument air & Service air to be provided. Pl. confirm, as bidder have considered common piping network for IA & SA application.	air system” in this regard.
176.	SECTION-VI / PART -A	VIFUNCTIONAL GUARANTEES & LIQUIDITY DAMAGES	23 OF 25	5.00.00 (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. We request NTPC to specify duty point for air compressors.	Duty point shall be 1.0. Bidder to comply with specification requirement.
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177.	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.	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. Cutting of trees and their disposal 2.Dismantling of any existing temporary/permanent structures and clearing debris. 3.Slope protection 4.Diversion of any existing facilities/structures, nalla, etc. 5.Stacked materials/equipments, etc. if any, located at proposed FGD area shall be cleared by owner. Please confirm.	Site clearance and minor grading as required is in bidder's scope. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard for details scope.
178.	VI/B	IV-D	6 OF 67	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.	For the subject clauses, kindly mention clearly 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.	Type of Building structure (RCC/ Steel), if not specified in the Technical Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any). Further, for RCC framed
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							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 67	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.		Bidder is requested to refer the amendment in this regard.
	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
179.	VI/B	IV-D	15 OF	4.01.00	The water from the pit shall overflow	Please provide the co-ordinates and	Refer General Layout
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			67		into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.	section (geometry and invert level) of owner's existing drains, where the storm water discharge from proposed FGD area shall be connected.	Plan. Road and drain drawing shall be provided after award if available.
180.	VI/B	IV-D	25 OF 67	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.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
181.	VI/B	IV-D	35 OF 67	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 is requested to comply the specification.
182.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
183.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
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184.	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.	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.	Minor grading as required is in bidder's scope.
185.	VI/A	II-A3	13 OF 33	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 IS 2911 Part-1 Section-2. Please confirm.	Bidder to comply the Technical Specification
186.	VI/A	II-A3	18 of 33	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
187.	VI/A	II-A3	27 to 41 of 49	Annexure-IV	Soil data and foundation system	Only Bore logs and laboratory test results are furnished. Please furnish the following additional data: 1. Electrical Resistivity Test Results. 2. Chemical analysis of ground water and sub soil samples	For available ERT & Chemical Analysis of subsoil, refer amendment
188.	-	-	-	-	General	Please furnish the Topographical Survey drawing showing contour and spot levels of the existing ground of the proposed FGD area.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of
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							award based on availability.
189.	VI / B	IV-D	9 of 67	3.14.01	The center to center distance between the pro-posed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 me-ters.	Bidder understands that the center of new chimney/chimneys shall be minimum 150m away from existing chimney & NDCT center. Please confirm.	Bidder's understanding is correct.
190.	VI / B	IV-D	13 of 67	3.14.08	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)	Bidder understands that no outer thermal insulation is required in case of borosilicate lining is adopted on inner surface of liner.	The thermal insulation shall be provided if required as per design.
191.	VI / B	IV	12 of 67	3.14.03	 Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall struc-tures located up to 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 envis-aged by the owner at the time testing, shall be de-termined along with the other topographical fea-tures of the local area through model test.	The location of new wet chimney shall be near to the existing chimney/NDCT in the space provided clearing foundation interface. The design of new wet chimney/chimneys shall be done considering interference factor with existing chimney/NDCT/other structures as determined by wind tunnel study. However, no design check or validation shall be done for existing chim-neys/NDCT/structures/building. Kindly confirm.	Bidder's understanding is correct.
192.	VI / B	IV-D	12 of 67	3.14.03	The minimum thickness of shell shall	The minimum thickness of shell shall	Minimum thickness of
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					not be less than 500mm.	be as per design requirement or codal provisions, whichever is higher. Please confirm.	shell shall not be less 500mm. Higher thickness shall be provided wherever required as per design.
193.	VI / B	IV-D	14 of 67	3.14.09	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.	Bidder understands that no painting is required on inner surface of concrete chimney shell below roof. Please confirm.	Bidder's understanding is correct.
194.	VI / A	V	10 of 23	4.01.01	A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor.	Bidder understands that the subject Chimney will not be operated under bypass mode.	Bidder understanding is correct
195.	VI / A	V	11 of 23	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 thick-ness, ...	Bidder understands that borosilicate glass block lining thickness is fixed as 38mm. Kindly confirm.	Borosilicate glass block lining thickness is minimum 38mm as per specification. However, if velocity is found higher than requirements specified as per EPRI for borosilicate lining and temperature of flue gas is higher, then higher thickness may be
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							required. Bidder to design accordingly
196.	VI / A	V	11 of 13	4.01.05	The minimum length of flue liner projecting over the chimney roof shall be at least equal to diameter of flue liner.	The maximum length projecting above the chimney roof shall be 6m to avoid additional wind forces on projected liner. Please confirm.	Bidder is requested to comply the specification requirement
197.	VI / A	V	11 of 23	4.01.05	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.	Bidder proposes to use concrete mini-shell (with borosilicate lining on inner surface and anti-corrosive paint on outer surface), in place of solid titanium/c-276 mini-shell. Please confirm.	Bidder is requested to comply the specification requirement
198.	VI / A	V	11 of 23	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 thick-ness, ...	Alternatively, bidder proposes to install borosilicate glass blocks directly on concrete surface for single flue chimneys. It will save structural steel for flue can, platform, solid titanium/c276 plate for minishell and fabrication & erection time for all structural steel works. Lift shall be provided outside chimney shell in this	Bidder is requested to comply the specification requirement
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						case. Kindly confirm.	
199.	SECTION – VI/ PART -A	SUB-SECTION- V	PAGE 8 OF 23	CLAUSE NO: 3.00.00 B Point-11	Chimney Height (m) Single Flue 180M	In 3X500MW Kahalgon-II Project bidder specification has asked for Chimney Height of 150M (Single Flue) and in 2X210MW(420MW) Kahalgon-I Project specification has asked for Chimney Height of 180M (Combined Single Flue). As the Power Output & Gas flows are lower in 2X210MW Kahalgon-I Project as compared to 500MW Kahalgaon-II Project, Customer is requested to review the chimney height for 2x210 MW Kahalgon-I Project.	MOEF norms are different for 200/210 MW and 500 MW. Applicable table outlet SO2 emission is higher in 200/210 MW as compare to 500 MW unit. Because of higher applicable outlet SO2 emission combined 200/210 MW chimney height is more as compare to single 500 MW unit
200.	SECTION- VI / PART -B	I-M3 COMPRESSOR 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. Please accept.	Bidder to comply with specification requirement. However, any superior Material may be accepted as per manufacturer proven design practice.
201.	SECTION- VI / PART	I-M3 COMPRESSOR	2 OF 6	4.00.00	Intercooler, Aftercooler & Oil coolers (For Screw)		
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	-B	D AIR SYST EM					
202.	SECT ION- VI / PART -B	I-M3 COM PRE SSE D AIR SYST EM	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. NTPC to confirm.	Bidder understanding is correct
203.	SECT ION- VI / PART -B	I-M3 COM PRE SSE D AIR SYST EM	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. NTPC to confirm.	Bidder's understanding is correct.
204.	SECT ION- VI / PART -A	III-A2 AIR CON DITIO NING , VENT ILATI	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.....	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. Please confirm, as bidder have considered common piping network	Bidder to refer tender drawing 0011-109-POM-A-006 "Schematic drawing of compressed air system" in this regard.
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		ON SYST EM & COM PRE SSE D AIR SYST EM				for IA & SA application.	
205.	SECT ION- VI / PART -A	VI FUN CTIO NAL GUA RAN TEES & LIQUI DITY DAM AGE S	23 OF 25	5.00.00 (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. We request NTPC to specify duty point for air compressors.	Duty point shall be 1.0. Bidder to comply with specification requirement.
206.	VI/C		5 of 83	7.02.00	It has been indicated that lifting devices to be provided for weight excess of 500 kg but demarcation criteria has not been indicated for	We propose that upto 2 tonnes capacity, manual hoist shall be provided. Electric hoist shall be provided for capacity more than 2	Bidder to note that for FGD system other than Limestone and gypsum handling plant, the
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					electric hoist & manual hoist.	tonnes &/or with lift more than 10 m. Above is inline with clause 4.09.00, part-A, page 10 of 12, section VI, sub section III-A5, LIME STONE & GYPSUM HANDLING PLANT. Kindly accept the same.	specification clause referred to be followed
207.	General				Technical requirements not indicated for electric hoists in air compressor house, ECW pump motor	We propose that electric hoists shall be class 2 duty as per IS 3938. Hoisting speed- 3-5 m/min Travelling speed- 10-15 m/min. Kindly accept the same.	Bidder is requested to refer the SUB-SECTION-I-M6 LIME STONE AND GYPSUM HANDLING PLANT(LHP & GHP) chapter for Hoist specification
208.	Section – VI, PART -A	Sub-Section III-A1	Page 8 of 12	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.	Bidder understands that pipe racks/pedestal need to be constructed in new area for FGD requirement. However, existing pipe racks/pedestal can be used for routing pipes/cables related to FGD system wherever need arises. Kindly confirm.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with technical Specification.
209.	Section – VI, PART -A	Sub-Section IV	Page 2 of 3	1.03.00 Sl. No. 7 Kahalgaon-II (3x 500	Process Water Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP STII.	Space for FGD lot 4 is shown in plot plan at 3 locations, near (3900E, 1800S-2100S), (4200E, 1800S) and (3900E-4200E,2400S). Hence kindly furnish the terminal point (TP) or	Bidder to obtain required details to from site visit. However, Terminal point location shall be as per Sub-Section-IV/Part-
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				MW)		clarify the header is closer to which of the area marked for FGD for process water tapings.	A/Section-VI of Technical specification.
210.	PART A/ SEC-TION - VI	IIIB	7 OF 13	1.10.00(2)	Cabling: Contractor scope shall include laying of cable from employer board.....FGD area in the contractor's scope.	1. We require space for cable in existing cable trays for incoming cables for 33KV FGD SWGR in existing cable trestle from main plant to FGD area. Kindly provide the space in cable trays for accommodating mentioned cables. 2. Please furnish drawings for Pipe & cable trestle along A and C Row. Please also furnish drawings for connectivity of cables from MV switchgear vault to Main plant cable trestle (trestle running along Mills). The same are not available and are required for establishing connectivity from main plant to FGD area. 3. Wherever there is no space in already running customer's trays, additional trays shall be provided by the bidder in the existing cable trestle. Kindly confirm that all trestles in main plant can bear additional loads of 8 no. 600 Wide cable trays for routing of	Please note that Bidder to make a survey of existing cable trestle to accommodate mentioned cables in the existing trestle. If space is not available for laying of cables in existing trays, the new additional cable trays shall be provided subject to availability of space in the trestle, otherwise separate cable trestle shall be provided for laying of cables. This is inline with Technical specification. Bidder please note there is no space in one section of trestle for 8 Nos of cable trays. Please also note that separate runway conductor run for his
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						cables for FGD. Total 8 no. cable trays from main plant to FGD area are required to be routed. 4. As per GLP space for new trestle may not be available hence contractor will lay cables by means of existing trestle or trenches or ductbanks or slits whatever possible during detail engineering. For cable laying necessary modification in existing cable trestle may also be done by contractor. Bidder is not considering any new structure for cable trestle in their pricing. please confirm. 5. Runway conductor available in customer's trestle will be utilized for Earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope.	scope of trays.
211.	PART C/	--	74 OF 83	--	Public Address system	Requirement of Public Address system is not mentioned anywhere in	Public Address System is excluded from bidder's
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	SECTION-VI					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.	scope of supply.
212.	PART B/ SECTION-VI	II-E15	5 OF 18	4.00.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number.	The lighting mast shall be provided as per the area requirement.
213.	PART B/ SECTION-VI	II-E6	12 of 27	4.04.04	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.	Single core cables in trefoil formation shall be laid with a distance of 2 times the diameter of cables between trefoil centre lines as per standard practice. Please confirm.	Technical specification is clear. Bidder to comply Technical specification.
214.	PART B/ SECTION-VI	II-E6	12 of 27	4.04.04	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.	Cable shall be clamped at every two meter or one meter as per clause 3.08.01 (page 8 of 27). Please confirm.	Technical specification is clear. Bidder to comply Technical specification.
215.	PART B-ii/	ELEC T-1	93 OF 100	0000-211-POE-A-030	Vertical support: 1) For 1 to 6 tier of 600mm tray -C2 channel	C1 channel shall be used upto 3 tier of 600mm tray	Technical specification is clear. Bidder to comply Technical specification.
216.	PART B/	II E-06	4 of 27	3.1.04	Cable troughs shall be required for branching out few cables from main	The following sentence may be considered instead of the sentence on	Technical specification is clear. Bidder to comply
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	SECTION-VI				cable route.	the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/ Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other clauses of specification since the specification also informs to use Slits, branch trays.)	Technical specification.
217.	PART B/ SECTION-VI	II E-06	9 of 27	3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type.	Self-locking, Nylon ties shall be used for clamping of multicore cables	Technical specification is clear. Bidder to comply Technical specification.
218.	PART B/ SECTION-VI	II E-06	12 of 27	4.4.09	Wherever few cables are branching out from main trunk route troughs shall be used.	The following sentence may be considered instead of the sentence on the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/ Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other	Technical specification is clear. Bidder to comply Technical specification.
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						clauses of specification since the specification also informs to use Slits, branch trays.)	
219.	PART B/ SECT ION- VI	II E- 06	13 of 27	4.4.14(3)	Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.	It shall be complied to the extent feasible for essential drives only	Technical specification is clear. Bidder to comply Technical specification.
220.	PART B/ SECT ION- VI	II E- 06	3 of 27	2.01.05	The cable vault.....maintenance of cables.	600mm wide and 2.1m high movement pas-sage shall be provided for walk ways in cable vaults / cable spreader room for easy maintenance of cables.	Technical specification is clear. Bidder to comply Technical specification.
221.	PART B/ SECT ION- VI	II E- 06	5 of 27	3.02.02(f)	Cantilever arms of 320mm, 620mm and 750mm ...with tray in position	Since only 600mm, 300mm and 150mm are to be installed as per technical specification, Cantilever arms of 300mm for 150mm wide tray, 450mm for 300mm wide tray and 750mm for 600mm wide cable tray shall be provided. The same is in line with other NTPC projects executed by Bidder.	Technical specification is clear. Bidder to comply Technical specification.
222.	PART B/	II E- 06	5 of 27	3.02.05(a)	All overhead cable routes.....on one route.	We understand that cables from main plant to FGD area shall be	Technical specification is clear bidder to comply
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	SECTION-VI					accommodated in space available in existing trays. For further requirement, trays shall be erected in existing cable trestle (customer scope). Please note that no separate cable trestle for cables from main plant to FGD area is envisaged.	Technical specification. Please note that bidder to make a survey and access the space availability. If space available cable shall be routed in trays or else separate trestle shall be made for routing of cables.
223.	PART B/ SECTION-VI	II E-15	4 of 18	3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here.	Illumination of only FGD area in scope is being considered. Please Confirm.	Bidder understanding is clear. This is inline with Technical specification
224.	PART B/ SECTION-VI	II E-15	9 of 18	14	In the hazardous areas like Hydrogen generation lighting shall be flameproof	Illumination of only FGD area in scope is being considered. Please Confirm.	Bidder understanding is clear. This is inline with Technical specification
225.	PART B/ SECTION-VI	II E-15	11 of 18	4.07.00	Occupancy based Passive Infra-red sensors	Please mention areas where sensors are to be used. As there is no office area, conference rooms etc. in FGD scope so these sensors are not being considered	Occupancy based Passive Infra-red sensors shall be used in office area, conference rooms etc. in FGD scope area if available.
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226.	PART B/ SECTION-VI	II E-15	15, 16, 17, 18	Annexure-A,B	Location	Illumination of only FGD area in scope is being considered. Please Confirm.	Bidder understanding is clear. This is inline with Technical specification.
227.	PART B/ SECTION-VI	II-E15	18 OF 18	Annexure-B, DC emergency Lighting	Lux level for DC lighting shall be as below:- Sl. Area Average Lux Level 1 . Unit Control Room -100 2. Control Equipment Room 100 3. Strategic Control Points (In TG Building & Boiler Area, Switchgear room, SWAS, Battery Room, UPS Area, TG Hall, Luboil Room etc.- 20	Lighting level by DC emergency lighting will be provided only to meet functional/ operational requirements. DC fixtures will be located at strategic locations such as near entrance, staircase, landings etc. for safe personnel movement during emergency".	Bidder understanding is clear. This is inline with Technical specification.
228.	PART B/ SECTION-VI	II E-14	1 of 9	2.01.00	Type A fire sealing system in CER & CCR.	Since CER & CCR is not in scope of FGD area, so Type A fire sealing system is not being considered. Only Type B fire sealing system shall be provided	Please note that Type B fire sealing system shall be provided for control panels and for remaining area's Type A fire sealing shall be used.
229.	General Layout	-	1 of 1	-	General	a)Kindly indicate the location of existing 33kV MUW line bays/Switchgear in plot plan and its	a)Bidder may refer GLP to estimate distance between Bidder's new
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	ut Plan					internal layout for bidder to calculate the length of HT incomer Cable. b)Kindly indicate the location of 33kV TIE Switchgear in plot plan. c) Kindly indicate the location of FGD TIE TRF #1 & 2 in Plot plan. d)Kindly provide all pipe & cable trestle layouts to establish the feasibility of routing of cables on existing pipe cum cable trestles. e) Owner to furnish Layout of Switch yard control room and layout of any existing switchgear room in switchyard area.	33KV switchgear and existing 33KV MUW bays located in switchyard area. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. b)Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. c) FGD TIE TRF #1 & 2 are in Bidder's scope. d), e)Same shall be provided to successful Bidder after award of contract.
230.	PART E	-	17 of 57	-	Key SLD General	a) Kindly provide the electrical loading (in amps) of existing 33kV MUW line bays for the bidder to calculate the HT incomer Cable requirement for Tie Feeder. b)Kindly inform the sizing criteria of incomer cable for 33kV TIE	a) Bidder may refer Tender SLD for feeder rating. b) Bidder to refer Clause no. 2.05.00 Of sub-Section IIIE-01, Part B of Technical
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231.	PART E	-	17 of 57	-	Key SLD General	Switchgear. From FGD TIE TRF #1& 2 to 33 kV Tie Swgr, Cable or bus duct connection both may please be considered as per the feasibility of layout.	Specification. Noted
232.	PART B/ SECTION-VI	II-E1	3 OF 8	2.01.00	FGD Tie transformers (if applicable) shall have ratings as specified in the tender SLD of relevant project.	Rating of FGD tie transformer # 1 & 2 is specified in SLD as 80MVA 132/34.5kV. Impedance of the transformer to be furnished by employer as sizing/study of FGD tie transformer is not in bidders scope.	Bidder to refer amendment in this regard.
233.	PART B/ SECTION-VI	II-E6	15 of 27	5.00.00	Earthing System	Please provide soil resistivity data.	It is in the scope of Bidder.
234.	PART B/ SECTION-VI	II-E6	15 of 27	5.01.00	Minimum two nos of risers shall be provided for each equipment in SG area	Riser shall be provided for equipment in FGD scope only and earthing shall be done for areas in FGD scope	Bidder understanding is clear. This is inline with Technical specification.
235.	VI/A	III-A4	3 OF 10	2.01.01 (a)	Cold water shall be pumped from CW OAC of stage-I to FGD clarified water tank through 3X100% capacity pumps....	Contradicting clauses. We understand that water shall be drawn directly from terminal point to the clarified water storage tanks through 3 X 100 %	Bidder is requested to refer the amendment in this regard
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236.	VI/A	III-A4	3 OF 10	2.01.01 (i)	One FGD clarified water tank.	pumps, as per cl. 2.01.01 (a), sub-section-III-A4, section-VI, Part-A. Kindly confirm the following: a) 3X100 % pumps are to be envisaged or 2X100 % pumps. b) One FGD clarified water storage tank shall be applicable OR two tanks shall be applicable. c) Storage capacity of Clarified water storage tank/tanks. Material of Construction (RCC or Carbon steel) of Clarified water storage tank	
237.	VI/B	I-M1	35 OF 51	13.03.04	Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps from terminal point shall be provided by the Contractor. The two tanks shall be interconnected with an isolation valve.	Contradicting clauses. We understand that water shall be drawn directly from terminal point to the clarified water storage tanks through 3 X 100 % pumps, as per cl. 2.01.01 (a), sub-section-III-A4, section-VI, Part-A. Kindly confirm the following:	
238.	VI/B	I-M1	35 OF 51	13.03.05	2x100% clarified water Pumps connected to each of the clarified water Storage tanks for each dewatering stream. Each pump	d) 3X100 % pumps are to be envisaged or 2X100 % pumps. e) One FGD clarified water	
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					catering to clarified water requirement of each dewatering stream.	storage tank shall be applicable OR two tanks shall be applicable. f) Storage capacity of Clarified water storage tank/tanks. Material of Construction (RCC or Carbon steel) of Clarified water storage tank	
239.	VI/B	I-M15	15 OF 15	ANNEXUR E-II (S. NO.2)	Maximum water available for KAHALGAON STPP STAGE-I & II is given as 585 Cum/hr	We understand that this water quantity is given for station (viz. Stage-I + Stage-II). Separate T.P. are specified for Stage-I and Stage-II. Accordingly kindly provide the maximum water available for stage-I and stage-II separately being separate Terminal points.	Bidder is requested to refer the amendment in this regard
240.	VI/A	III-A4	3 OF 10	2.01.01 (a)	Cold water shall be pumped from CW OAC of stage-I to FGD clarified water tank through 3X100% capacity pumps....	Terminal point "CW OAC" is not clear. This location is also not available in plot plan. Kindly inform the exact location and full form of "CW OAC."	OAC implies to "Open Approach Channel"
241.	VI/A	IV, T.P. & EXCL.	2 OF 3	1.03.00 (6)	Water shall be pumped from suitable location of stage-I CW OAC.		
242.	VI/A	III-A4	3 OF 10	2.01.01 (d)	6 x 25 % (4 Working + 2 standby)	As the clarified water is being pumped	Bidder is requested to
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					capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. With necessary pipe line and valves etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water.	from clarified water storage tanks to process water tanks, through PHEs and accordingly FGD ACW pumps/system shall be flooded. Hence 6x100 % auto priming system for Auxiliary (Secondary) Cooling water pumps system is not required. In none of the FGD tenders viz. Lot-1/Lot-2/Lot-3/any other tender of Lot-4, such type of auto priming pumps are not specified/envisaged. Kindly confirm.	refer the amendment in this regard
243.	VI/A	III-A4	3 OF 10	2.01.01 (e)	6x100 % (4 Working + 2 standby) auto priming system for Auxiliary (Secondary) Cooling water pumps system.		
244.	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.	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. Cutting of trees and their disposal 2.Dismantling of any existing temporary/permanent structures and clearing debris. 3.Slope protection 4.Diversion of any existing facilities/structures, nalla, etc. 5.Stacked materials/equipments, etc. if any, located at proposed FGD area shall be cleared by owner.	Site clearance and minor grading as required is in bidder's scope. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard for details scope.
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						Please confirm.	
245.	VI/B	IV-D	6 OF 67	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.	For the subject clauses, kindly mention clearly 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.	Type of Building structure (RCC/ Steel), if not specified in the Technical 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 67	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		Bidder is requested to refer the amendment in this regard.
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					sheets (to be used as permanent shuttering only) over structural beams. 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.		Bidder is requested to refer the amendment in this regard.
246.	VI/B	IV-D	15 OF 67	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.	Refer General Layout Plan. Road and drain drawing shall be provided after award if available.
247.	VI/B	IV-D	25 OF 67	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.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
248.	VI/B	IV-D	35 OF 67	22.00.00	Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking	Bidder shall obtain approval of Civil / Architectural drawings from customer/customer's consultant	Bidder is requested to comply the specification.
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					up the construction work.	before taking up the construction work. Please confirm.	
249.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
250.	VI/B	IV-D	47 OF 67	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.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
251.	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.	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.	Minor grading as required is in bidder's scope.
252.	VI/A	II-A2	12 OF 35	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 IS 2911 Part-1 Section-2. Please confirm.	Bidder to comply the Technical Specification
253.	VI/A	II-A2	-	Annexure-IV	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	For available Lab test result, ERT & Chemical Analysis of ground water and subsoil, refer amendment.
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						3. Chemical analysis of ground water and sub soil samples	
254.	VI/A	II-A2	-	Annexure-IV	Soil data and foundation system	Co-ordinates of Bore holes BH-5 & 6 done by Bose Engineers are given in X & Y co-ordinates. However, all other bore holes are given in S & E co-ordinates. Plot plan is in South & East co-ordinates. Hence for clarity, please furnish the co-ordinates of BH-5 & 6 done by Bose Engineers in South & East co-ordinates.	For location of bore holes 5&6 refer plan of field investigation furnished in amendment.
255.	-	-		-	General	Please furnish the Topographical Survey drawing showing contour and spot levels of the existing ground of the proposed FGD area.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
256.	VI / B	IV-D	9 of 67	3.14.01	The center to center distance between the pro-posed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 me-ters.	Bidder understands that the center of new chimney/chimneys shall be minimum 150m away from existing chimney & NDCT center. Please confirm.	Bidder's undersanding is correct.
257.	VI / B	IV-D	13 of 67	3.14.08	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)	Bidder understands that no outer thermal insulation is required in case	The thermal insulation shall be provided if
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						of borosilicate lining is adopted on inner surface of liner. Please confirm.	required as per design.
258.	VI / B	IV	12 of 67	3.14.03	 Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located up to 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.	The location of new wet chimney shall be near to the existing chimney/NDCT in the space provided clearing foundation interface. The design of new wet chimney/chimneys shall be done considering interference factor with existing chimney/NDCT/other structures as determined by wind tunnel study. However, no design check or validation shall be done for existing chimneys/NDCT/structures/building. Kindly confirm.	Bidder's understanding is correct.
259.	VI / B	IV-D	12 of 67	3.14.03	The minimum thickness of shell shall not be less than 500mm.	The minimum thickness of shell shall be as per design requirement or codal provisions, whichever is higher. Please confirm.	Minimum thickness of shell shall not be less than 500mm. Higher thickness shall be provided wherever required as per design.
260.	VI / B	IV-D	14 of 67	3.14.09	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	Bidder understands that no painting is required on inner surface of concrete chimney shell below roof. Please confirm.	Bidder's understanding is correct.
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261.	VI / A	V	10 of 23	4.01.01	having total 220 microns DFT. A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor.	Bidder understands that the subject Chimney will not be operated under bypass mode. Please confirm.	Bidder understanding is correct
262.	VI / A	V	11 of 23	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 thick-ness, ...	Bidder understands that borosilicate glass block lining thickness is fixed as 38mm. Please confirm.	Borosilicate glass block lining thickness is minimum 38mm as per specification. However, if velocity is found higher than requirements specified as per EPRI for borosilicate lining and temperature of flue gas is higher, then higher thickness may be required. Bidder to design accordingly
263.	VI / A	V	11 of 13	4.01.05	The minimum length of flue liner projecting over the chimney roof shall be at least equal to diameter of flue liner.	The maximum length projecting above the chimney roof shall be 6m to avoid additional wind forces on projected liner. Please confirm.	Bidder is requested to comply the specification requirement.
264.	VI / A	V	11 of 23	4.01.05	For Borosilicate lining, the top flue	Bidder proposes to use concrete mini-	Bidder is requested to
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					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.	shell (with borosilicate lining on inner surface and anti corrosive paint on outer surface), in place of solid titanium/c-276 mini-shell. Please confirm.	comply the specification requirement.
265.	VI / A	V	11 of 23	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 thick-ness, ...	Alternatively, bidder proposes to install borosilicate glass blocks directly on concrete surface for single flue chimneys. It will save structural steel for flue can, platform, solid titanium/c276 plate for minishell and fabrication & erection time for all structural steel works. Lift shall be provided outside chimney shell in this case. Kindly confirm.	Bidder is requested to comply the specification requirement.
266.	PART A/	IIIB	7 OF 13	1.10.00(2)	Cabling: Contractor scope shall include laying of cable from employer	1. We require space for cable in existing cable trays for incoming	Bidder to make a survey of existing cable trestle to
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	SECTION - VI				board.....FGD area in the contractor's scope.	cables for 33KV FGD SWGR in existing cable trestle from main plant to FGD area. Kindly provide the space in cable trays for accommodating mentioned cables. 2. Please furnish drawings for Pipe & cable trestle along A and C Row. Please also furnish drawings for connectivity of cables from MV switchgear vault to Main plant cable trestle (trestle running along Mills). The same are not available and are required for establishing connectivity from main plant to FGD area. 3. Wherever there is no space in already running customer's trays, additional trays shall be provided by the bidder in the existing cable trestle. Kindly confirm that all trestles in main plant can bear additional loads of 8 no. 600 Wide cable trays for routing of cables for FGD. Total 8 no. cable trays from main plant to FGD area are required to be routed. 4. As per GLP space for new trestle may not be available hence contractor	access the space availability. If space available the cable shall be routed in the existing trestle or else separate cable trestle shall be provided. Please note that cable shall be routed only in trestle and separate earthing conductor shall be provided for trays where cable trays are provided by bidder.
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						will lay cables by means of existing trestle or trenches or ductbanks or slits whatever possible during detail engineering. For cable laying necessary modification in existing cable trestle may also be done by contractor. Bidder is not considering any new structure for cable trestle in their pricing. Please confirm. 5. Runway conductor available in customer's trestle will be utilized for earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope.	
267.	PART B/ SECT ION-VI	II-E15	5 OF 18	4.00.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number.	The lighting mast shall be provided as per the requirement/area lighting.
268.	PART C/	--	74 OF 83	--	Public Address system	Requirement of Public Address system is not mentioned anywhere in	Public Address System is excluded from bidder's
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	SECTION-VI					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.	scope of supply.
269.	PART B/ SECTION-VI	II-E6	12 of 27	4.04.04	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.	Single core cables in trefoil formation shall be laid with a distance of 2 times the diameter of cables between trefoil centre lines as per standard practice. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
270.	PART B/ SECTION-VI	II-E6	12 of 27	4.04.04	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.	Cable shall be clamped at every two meter or one meter as per clause 3.08.01 (page 8 of 27). Please confirm.	Technical specification is clear and bidder to comply Technical specification.
271.	PART B-ii/	ELECT-1	93 OF 100	0000-211-POE-A-030	Vertical support: 1) For 1 to 6 tier of 600mm tray -C2 channel	C1 channel shall be used upto 3 tier of 600mm tray. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
272.	PART B/ SECTION-VI	II E-06	4 of 27	3.1.04	Cable troughs shall be required for branching out few cables from main cable route.	The following sentence may be considered instead of the sentence on the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/	Technical specification is clear and bidder to comply Technical specification.
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						Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other clauses of the specification since the specification also informs to use Slits, branch trays.)	
273.	PART B/ SECT ION-VI	II E-06	9 of 27	3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type.	Self-locking, Nylon ties shall be used for clamping of multicore cables.	Technical specification is clear and bidder to comply Technical specification.
274.	PART B/ SECT ION-VI	II E-06	12 of 27	4.4.09	Wherever few cables are branching out from main trunk route troughs shall be used.	The following sentence may be considered instead of the sentence on the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/ Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other clauses of the specification since the specification also informs to use Slits, branch trays.)	Technical specification is clear and bidder to comply Technical specification.
275.	PART	II E-	13 of 27	4.4.14(3)	Power and control cables for AC	It shall be complied to the extent	Technical specification is
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	B/ SECT ION- VI	06			drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.	feasible for essential drives only.	clear and bidder to comply Technical specification.
276.	PART B/ SECT ION- VI	II E- 06	3 of 27	2.01.05	The cable vault.....maintenance of cables.	600mm wide and 2.1m high movement passage shall be provided for walk ways in cable vaults / cable spreader room for easy maintenance of cables.	Technical specification is clear and bidder to comply Technical specification.
277.	PART B/ SECT ION- VI	II E- 06	5 of 27	3.02.02(f)	Cantilever arms of 320mm, 620mm and 750mm ...with tray in position	Since only 600mm, 300mm and 150mm are to be installed as per technical specification, Cantilever arms of 300mm for 150mm wide tray, 450mm for 300mm wide tray and 750mm for 600mm wide cable tray shall be provided. The same is in line with other NTPC projects executed by the bidder.	Technical specification is clear and bidder to comply Technical specification.
278.	PART B/ SECT ION- VI	II E- 06	5 of 27	3.02.05(a)	All overhead cable routes.....on one route.	We understand that cables from main plant to FGD area shall be accommodated in space available in existing trays . For further requirement , trays shall be erected in existing	Bidder to make a survey of existing cable trestle to access the space availability. If space available the cable shall
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						cable trestle (customer scope) . Please note that no separate cable trestle for cables from main plant to FGD area is envisaged.	be routed in the existing trestle or else separate cable trestle shall be provided. Please note that cable shall be routed only in trestle and separate earthing conductor shall be provided for trays where cable trays are provided by bidder.
279.	PART B/ SECT ION- VI	II-E7	6 of 6	5.00.00	The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (Forms & Procedures) and the same shall be considered for the evaluation of the bids.	Our offer includes mandatory type test for HT XLPE Power Cable . Cost of type test for HT XLPE power Cables are included in offer price. No separate charges for type test shall be indicated in Section - VII- (Forms & Procedures) by the bidder.	Technical specification is clear and bidder to comply Technical specification.
280.	PART B/ SECT ION- VI	II E- 15	4 of 18	3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here.	Illumination of only FGD area in scope are being considered	Bidder understanding is clear. This is inline with Technical specification.
281.	PART	II E-	9 of 18	14	In the hazardous areas like	Illumination of only FGD area in scope	Bidder understanding is
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	B/ SECT ION- VI	15			Hydrogen generation lighting shall be flameproof	are being considered	clear. This is inline with Technical specification.
282.	PART B/ SECT ION- VI	II E- 15	11 of 18	4.07.00	Occupancy based Passive Infra-red sensors	Please mention areas where sensors are to be used. As there is no office area, conference rooms etc. in FDG scope so these sensors are not being considered	Occupancy based Passive Infra-red sensors shall be used in office area, conference rooms etc. in FGD scope area if available.
283.	PART B/ SECT ION- VI	II E- 15	15, 16, 17, 18	Annexure- A,B	Location	Illumination of only FGD area in scope are being considered	Bidder understanding is clear. This is inline with Technical specification.
284.	PART B/ SECT ION- VI	II-E15	18 OF 18	Annexure- B, DC emergency Lighting	Lux level for DC lighting shall be as below:- Sl. Area Average Lux Level 1 . Unit Control Room -100 2. Control Equipment Room 100 3. Strategic Control Points (In TG Building & Boiler Area, Switchgear room, SWAS, Battery Room, UPS Area,	Lighting level by DC emergency lighting will be provided only to meet functional/ operational requirements. DC fixtures will be located at strategic locations such as near entrance, staircase, landings etc. for safe personnel movement during emergency".	Bidder understanding is clear. This is inline with Technical specification.
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					TG Hall, Luboil Room etc. - 20		
285.	PART B/ SECTION-VI	II E-14	1 of 9	2.01.00	Type A fire sealing system in CER & CCR.	Since CER & CCR is not in scope of FGD area, so Type A fire sealing system is not being considered. Only Type B fire sealing system shall be provided	Please note that Type B fire sealing system shall be provided for control panels and for remaining area's Type A fire sealing shall be used.
286.	PART B/ SECTION-VI	II-E6	15 of 27	5.00.00	Earthing System	Please provide soil resistivity data	It is in bidder scope.
287.	PART B/ SECTION-VI	II-E6	15 of 27	5.01.00	Minimum two nos of risers shall be provided for each equipment in SG area	Riser shall be provided for equipment in FGD scope only and earthing shall be done for areas in FGD scope	Bidder understanding is clear. This is inline with Technical specification.
288.	General Layout Plan	-	1 of 1	-	General	a)Kindly indicate the location of existing 33KV Switchgear and new 33 kv Switchgear in plot plan and existing 33KV Switchgear internal layout for bidder to calculate the length of HT Tie Cable. b)Kindly provide all pipe & cable trestle layouts to establish the	Please refer tender drawings
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						feasibility of routing of cables on existing pipe cum cable trestles. c) Owner to furnish Layout of Switchyard control room and layout of any existing switchgear room in switchyard area.	
289.	PART E	-	17 of 57	-	Key SLD General	a)Kindly provide the Electrical loading (in Amps)of existing 33 kv Switchgear for the bidder to calculate the HT incomer Cable requirement for Tie Feeder. b)Kindly inform the sizing criteria of incomer cable for new 33 KV Switchgear	Feeder ratings are indicated in Tender SLD. Bidder to refer Clause 2.05.00 of Sub-Section IIE-01, Part-B of Technical specification.
290.	PART E	-	17 of 57	-	Key SLD General	From FGD TIE trf #1 ,2&3 to 33 kV Tie swgr, Cable or busduct connection both may please be considered as per the feasibility of layout.	Bidder to follow Technical specification requirement.
291.	General Layout Plan	-	1 of 1	-	General	Kindly indicate the location of FGD TIE trf #1,2 &3.	Bidder to refer GLP wherein space for FGD is indicated in switchyard area. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities and space
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292.	SECT ION- VI / PART -B	I-M3 COM PRE SSE D AIR SYST EM	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 BHEL for NTPC and other customers. Please accept.	availability etc. Bidder to comply with specification requirement. However, any superior Material may be accepted as per manufacturer proven design practice.
293.	SECT ION- VI / PART -B	I-M3 COM PRE SSE D AIR SYST EM	2 OF 6	4.00.00	Intercooler, Aftercooler & Oil coolers (For Screw)		
294.	SECT ION- VI / PART -B	I-M3 COM PRE SSE D AIR SYST EM	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 understanding is correct

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295.	SECTION- VI / PART -B	I-M3 COMPRESSOR D 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. Please confirm.	Bidder's understanding is correct.
296.	SECTION- VI / PART -A	III-A2 AIR CONDITIONING , VENTILATION SYSTEM & COMPRESSOR D 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.....	Customer 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. Please confirm, as bidder have considered common piping network for IA & SA application.	Bidder to refer tender drawing 0011-109-POM-A-006 "Schematic drawing of compressed air system" in this regard.
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297.	SECTION- VI / PART -A	VI FUNCTIONAL GUARANTEES & LIQUIDITY DAMAGES	23 OF 25	5.00.00 (xxiii)	Total power consumption at motor input terminal at rated duty of air compressor.....	Bidder request customer 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 customer. In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements. Customer is requested to specify duty point for air compressors.	Duty point shall be 1.0. Bidder to comply with specification requirement.
298.	VI/C		5 of 83	7.02.00	It has been indicated that lifting devices to be provided for weight excess of 500 kg but demarcation criteria has not been indicated for electric hoist & manual hoist.	We propose that upto 2 tonnes capacity, manual hoist shall be provided. Electric hoist shall be provided for capacity more than 2 tonnes &/or with lift more than 10 m. Above is in line with clause 4.09.00, part-A, page 10 of 12, section VI, sub section III-A5, LIME STONE & GYPSUM HANDLING PLANT. Please accept.	Bidder to note that for FGD system other than Limestone and gypsum handling plant, the specification clause referred to be followed
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299.	General				Technical requirements not indicated for electric hoists in air compressor house, ECW pump motor	We propose that electric hoists shall be class 2 duty as per IS 3938. Hoisting speed- 3-5 m/min Travelling speed- 10-15 m/min. Please accept.	Bidder is requested to refer the SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) chapter for Hoist specification
300.	Section – VI, PART -A	Sub-Section III- Scope of Supply and services.	Page 5 of 6	1.11.00	Existing pipe /cable trestle, conveyors etc. passing through the proposed FGD area shall retained and FGD layout shall be prepared accordingly	Bidder understands that pipe racks/pedestal need to be constructed in new area for FGD requirement. However, existing pipe racks/pedestal can be used for routing pipes/cables related to FGD system wherever need arises. Please confirm.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with technical Specification.

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301.	Section – VI, PART -A	Sub-Section IV-Terminal points and exclusion	Page 1 and 2 of 4	1.03.00	Terminal point for Process Water: FGUTPP stage II & III : shall be tapped from the existing blow down header of stage II & III available near FGD area. Farakka STPP ST-III: Shall be tapped off suitably from the existing blow down header available near FGD area of of stage III.	Blowdown header is not appearing near proposed FGD areas in per available PLOT PLAN. Hence kindly furnish exact terminal point (TP) for process water tapplings.	Indicative routing of CWBD piping has already been shown in the tender GLP for FGUTPP in St-III area (within Block area 16B+00 to 17B+11 and 11A+00 to 15A+00). However, Terminal point location shall be as per Sub-Section-IV/Part-A/Section-VI of Technical specification. Further, required details to be obtained from the site visit. Exact location of terminal point will be finalized during detailed engineering in case of award. CW Blowdown header is available from CWPH area to AWPB. However, Terminal point location shall be as per Sub-Section-IV/Part-A/Section-VI of Technical specification. Exact location of terminal point will be finalized during detailed engineering in case of award.
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302.	Section – VI, PART -A	Sub-Section IV-Terminal points and exclusion	Page 1 and 2 of 4	1.03.00	Terminal point for Process Water: Farakka Stage II :shall be tap off suitably from service water tank of Farakka STPP ST-II.	Location of service water tank is not available in plot plan. Hence kindly furnish the location of service water tank.	Tentative location of the service water tank is 1010 S/1135 E.
303.	SECTION – VI/ PART -A	SUB-SECTION-V	PAGE 5 OF 23	CLAUSE NO: 3.00.00 A	Chimney Height (m) Single Flue 180M	For 500MW Projects (Farakka-II & III), specification has asked for Chimney Height of 150M (Single Flue) and for 2X210MW (420MW) Unchahar-I specification has asked for Chimney Height of 180 M (Combined Single Flue). As the Power Output & Gas flows are lower for Unchahar-I Project than that of Farakka-II & III projects and further as per latest MoEF guidelines, the required chimney height for Unchahar-I is much less than 180 m, Customer is requested to review the chimney height.	MOEF norms are different for 200/210 MW and 500 MW. Applicable outlet SO2 emission is higher in 200/210 MW as compare to 500 MW unit. Because of higher applicable outlet SO2 emission combined 200/210 MW chimney height is more as compare to single 500 MW unit

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304.	SECTION – VI/ PART -A	SUB-SECTION-V	PAGE 9 OF 23	CLAUSE NO: 3.00.00 C	Chimney Height (m) Single Flue 225 M	For 500MW Projects (Farakka-II & III), specification has asked for Chimney Height of 150M (Single Flue) and for 2X210MW + 1x 210 MW (630MW) Unchahar-II & III Projects specification has asked for Chimney Height of 225 M (Combined Single Flue). As the Power Output & Gas flows are comparable for Unchahar-II & III Projects and Farakka-II & III projects and further as per latest MoEF guidelines, the required chimney height for Unchahar-II & III is much less than 225 m, Customer is requested to review the chimney height.	MOEF norms are different for 200/210 MW and 500 MW. Applicable outlet SO2 emission is higher in 200/210 MW as compare to 500 MW unit. Because of higher applicable outlet SO2 emission combined 200/210 MW chimney height is more as compare to single 500 MW unit

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305.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1 of 3	1.03.00	For FGUTPP-II & III, process water, shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Bidder understands that Tapping shall be taken either from blow down header of stage- II or stage III which will be nearest to the FGD area. Please confirm.	Bidder is requested to refer the amendment in this regard
306.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1 of 3	1.03.00	For FGUTPP-II & III, process water, shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Please inform the Pressure available at Terminal point & TP Elevation from the existing CW blow down header of stage- II & III.	Bidder is requested to refer the amendment in this regard

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307.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	1 OF 10	1.01.01	Cold secondary water shall be tapped from existing clarified water tank of FGUTPP ST-I and pumped to FGD clarified water tank through 3 x100%	Bidder understands that existing clarified water tank is aboveground tank and flooded / positive suction shall be available (at customer Terminal point) for Horizontal centrifugal pumps (3x100%) to be provided by bidder.	Bidder is requested to refer the amendment in this regard
308.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	1 OF 10	1.01.01 (h)	One FGD clarified water tank.	Details (MOC etc.) & Capacity of FGD clarified water tank (to be provided by bidder) are not available in specification. Please provide the Tank capacity & other details.	Bidder is requested to refer the amendment in this regard
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309.	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.	Since leveling and grading of proposed FGD area is in the scope of customer, bidder understands following works are in the scope of the customer: 1. Cutting of trees and their disposal 2.Dismantling of any existing temporary/permanent structures and clearing debris. 3.Slope protection 4.Diversion of any existing facilities/structures, nalla, etc. 5.Stacked materials/equipments, etc. if any, located at proposed FGD area shall be cleared by owner. Please confirm.	Site clearance and minor grading as required is in bidder's scope. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard for details scope.

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310.	VI/B	IV-D	6 OF 67	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.	For the subject clauses, please clarify whether the frame is of Structural steel or RCC. Further, bidder understands that for RCC framed buildings, roof/floor shall be without profile metal deck sheets, using normal removable shuttering. Please confirm.	Type of Building structure (RCC/ Steel), if not specified in the Technical 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).

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	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
	VI/B	IV-D	15 OF 67	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.		Bidder is requested to refer the amendment in this regard.
311.	VI/B	IV-D	15 OF 67	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 customer's existing drains, where the storm water discharge from proposed FGD area shall be connected.	Refer General Layout Plan. Road and drain drawing shall be provided after award if available.

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312.	VI/B	IV-D	25 OF 67	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 customer's existing sewage network, where the sewer pipe line from the proposed FGD area shall be connected.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
313.	VI/B	IV-D	35 OF 67	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 is requested to comply the specification.
314.	VI/B	IV-D	47 OF 67	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 customer's service water terminal point.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
315.	VI/B	IV-D	47 OF 67	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 customer's potable water terminal point.	Bidder is requested to visit site and familiarize himself of site condition for any existing facilities
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316.	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.	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.	Minor grading as required is in bidder's scope.
317.	VI/A	II-A1	13 OF 49	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 IS 2911 Part-1 Section-2. Please confirm.	Bidder to comply the Technical Specification
318.	VI/A	II-A1	23 OF 49	Annexure-III b)	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.	The maximum allowable bearing pressure shall be as per the approved geotechnical report during detailed engineering. Please confirm.	Bidder to comply the Technical Specification

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319.	VI/A	II-A1	18 of 49	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.	Contractor is required to carry out geotechnical investigation in this area. During detailed engineering, pile capacity shall be adopted after approval of geotechnical investigation report. However, the pile capacity shall be least of the three values i.e. as per approved geotechnical report, as per the values furnished in Technical Specification and pile capacity achieved in pile load tests. The Net 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.
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320.	VI/A	II-A1	27 to 41 of 49	Annexure-IV	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 samples	For Lab test result bidder may refer Borelog. For ERT & Chemical Analysis of ground water and subsoil, refer amendment.
321.	VI/A	II-A1	27 to 41 of 49	Annexure-IV	Soil data and foundation system	Co-ordinates of Bore holes BH-3,4,7 & 8 are given in UTM co-ordinates and rest of bore holes are in A & B co-ordinates. Plot plan is in A & B co-ordinates. Hence for clarity, please furnish the co-ordinates of BH-3,4,7 & 8 in A & B co-ordinates.	For location of bore holes 3, 4, 7&8 refer plan of field investigation already furnished in Technical Spec
322.	-	-	-	-	General	Please furnish the Topographical Survey drawing showing contour and spot levels of the existing ground of the proposed FGD area.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
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323.	VI / B	IV-D	9 of 67	3.14.01	The center to center distance between the pro-posed chimney(s) and the existing chimney(s) & NDCT in any direction shall not be less than 150 me-ters.	Bidder understands that the center of new chimney/chimneys shall be minimum 150m away from existing chimney & NDCT center. Please confirm.	Bidder's understanding is correct.
324.	VI / B	IV-D	13 of 67	3.14.08	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)	Bidder understands that no outer thermal insulation is required in case of borosilicate lining is adopted on inner surface of liner.	The thermal insulation shall be provided if required as per design.
325.	VI / B	IV	12 of 67	3.14.03	 Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall struc-tures located up to 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 envis-aged by the owner at the time testing, shall be de-termined along with the other topographical fea-tures of the local area through model test.	The location of new wet chimney shall be near to the existing chimney/NDCT in the space provided clearing foundation interface. The design of new wet chimney/chimneys shall be done considering interference factor with existing chimney/NDCT/other structures as determined by wind tunnel study. However, no design check or validation shall be done for existing chimneys/NDCT/structures/building. Please confirm.	Bidder's understanding is correct.
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326.	VI / B	IV-D	12 of 67	3.14.03	The minimum thickness of shell shall not be less than 500mm.	The minimum thickness of shell shall be as per design requirement or codal provisions, whichever is higher. Please confirm.	Minimum thickness of shell shall not be less 500mm. Higher thickness shall be provided wherever required as per design.
327.	VI / B	IV-D	14 of 67	3.14.09	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.	Bidder understands that no painting is required on inner surface of concrete chimney shell below roof. Please confirm.	Bidder's understanding is correct.
328.	VI / A	V	10 of 23	4.01.01	A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor.	Bidder understands that the subject Chimney will not be operated under bypass mode. Please confirm.	Bidder understanding is correct.

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329.	VI / A	V	11 of 23	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 thick-ness, ...	Bidder understands that borosilicate glass block lining thickness is fixed as 38mm. Please confirm.	Borosilicate glass block lining thickness is minimum 38mm as per specification. However, if velocity is found higher than requirements specified as per EPRI for borosilicate lining and temperature of flue gas is higher, then higher thickness may be required. Bidder to design accordingly
330.	VI / A	V	11 of 13	4.01.05	The minimum length of flue liner projecting over the chimney roof shall be at least equal to diameter of flue liner.	The maximum length projecting above the chimney roof shall be 6m to avoid additional wind forces on projected liner. Please confirm.	Bidder is requested to comply the specification requirement.

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331.	VI / A	V	11 of 23	4.01.05	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.	Bidder proposes to use concrete mini-shell (with borosilicate lining on inner surface and anti-corrosive paint on outer surface), in place of solid titanium/c-276 mini-shell. Please confirm.	Bidder is requested to comply the specification requirement.
332.	VI / A	V	11 of 23	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 thick-ness, ...	Alternatively, bidder proposes to install borosilicate glass blocks directly on concrete surface for single flue chimneys. It will save structural steel for flue can, platform, solid titanium/c276 plate for mini shell and fabrication & erection time for all structural steel works. Lift shall be provided outside chimney shell in this case. Please confirm.	Bidder is requested to comply the specification requirement.

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333.	PART A/ SEC-TION - VI	IIIB	7 OF 13	1.10.00(2)	Cabling: Contractor scope shall include laying of cable from employer board.....FGD area in the contractor's scope.	1. We require space for cable in existing cable trays for incoming cables for 33KV FGD SWGR in existing cable trestle from main plant to FGD area. Kindly provide the space in cable trays for accommodating mentioned cables. 2. Please furnish drawings for Pipe & cable trestle along A and C Row. Please also furnish drawings for connectivity of cables from MV switchgear vault to Main plant cable trestle (trestle running along Mills). The same are not available and are required for establishing connectivity from main plant to FGD area. 3. Wherever there is no space in already running customer's trays, additional trays shall be provided by the bidder in the existing cable trestle. Kindly confirm that all trestles in main plant can bear additional loads of 8 no. 600 Wide cable trays for routing of cables for FGD. Total 8 no. cable trays from main plant to FGD area are required to be routed. 4. As per GLP space for new trestle may not be available hence bidder will lay cables by means of existing trestle or trenches or duct banks or slits whatever possible during detail engineering. For cable laying necessary modification in existing cable trestle may also be done by contractor. Bidder is not considering any new structure for cable trestle in their pricing. please confirm. 5. Runway conductor available in customer's trestle will be utilized for earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope.	Bidder to make a survey of existing cable trestle to access the space availability. If space available the cable shall be routed in the existing trestle or else separate cable trestle shall be provided. Please note that cable shall be routed only in trestle and separate earthing conductor shall be provided for trays where cable trays are provided by bidder.
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334.	PART B/ SECTION-VI	II-E15	5 OF 18	4.00.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number	Lighting masts to be provided as per the requirement/Area lighting
335.	PART C/ SECTION-VI	--	74 OF 83	--	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.	Public Address System is excluded from bidder's scope of supply.
336.	PART B/ SECTION-VI	II-E6	12 of 27	4.04.04	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.	Single core cables in trefoil formation shall be laid with a distance of 2 times the diameter of cables between trefoil center lines as per standard practice. Please confirm.	Technical specification is clear and bidder to comply Technical specification.

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337.	PART B/ SECT ION- VI	II-E6	12 of 27	4.04.04	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.	Cable shall be clamped at every two meter or one meter as per clause 3.08.01 (page 8 of 27). Please confirm.	Technical specification is clear and bidder to comply Technical specification.
338.	PART B-ii/	ELEC T-1	93 OF 100	0000-211- POE-A-030	Vertical support: 1) For 1 to 6 tier of 600mm tray -C2 channel	C1 channel shall be used upto 3 tier of 600mm tray. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
339.	PART B/ SECT ION- VI	II E- 06	4 of 27	3.1.04	Cable troughs shall be required for branching out few cables from main cable route.	The following sentence may be considered instead of the sentence on the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/ Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other clauses specification since the specification also informs to use Slits, branch trays.)	Technical specification is clear and bidder to comply Technical specification.
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340.	PART B/ SECT ION-VI	II E-06	9 of 27	3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type.	Self-locking, Nylon ties shall be used for clamping of multicore cables. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
341.	PART B/ SECT ION-VI	II E-06	12 of 27	4.4.09	Wherever few cables are branching out from main trunk route troughs shall be used.	The following sentence may be considered instead of the sentence on the left column mentioned in the specification i.e. "Wherever few cables are branching out from main trunk route troughs/ Local Buried Pipe / Slit / Branch Trays shall be used. Please confirm. (The above is in line with other clauses specification since the specification also informs to use Slits, branch trays.)	Technical specification is clear and bidder to comply Technical specification.
342.	PART B/ SECT ION-VI	II E-06	13 of 27	4.4.14(3)	Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.	It shall be complied to the extent feasible for essential drives only. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
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343.	PART B/ SECTION-VI	II E-06	3 of 27	2.01.05	The cable vault.....maintenance of cables.	600mm wide and 2.1m high movement passage shall be provided for walk ways in cable vaults / cable spreader room for easy maintenance of cables. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
344.	PART B/ SECTION-VI	II E-06	5 of 27	3.02.02(f)	Cantilever arms of 320mm, 620mm and 750mm ...with tray in position	Since only 600mm, 300mm and 150mm are to be installed as per technical specification, Cantilever arms of 300mm for 150mm wide tray, 450mm for 300mm wide tray and 750mm for 600mm wide cable tray shall be provided. The same is in line with other NTPC projects executed by BHEL. Please confirm.	Technical specification is clear and bidder to comply Technical specification.

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345.	PART B/ SECTION- VI	II E- 06	5 of 27	3.02.05(a)	All overhead cable routes.....on one route.	We understand that cables from main plant to FGD area shall be accommodated in space available in existing trays. For further requirement, trays shall be erected in existing cable trestle (customer scope). Please note that no separate cable trestle for cables from main plant to FGD area is envisaged.	Bidder to make a survey of existing cable trestle to access the space availability. If space available the cable shall be routed in the existing trestle or else separate cable trestle shall be provided. Please note that cable shall be routed only in trestle and separate earthing conductor shall be provided for trays where cable trays are provided by bidder.
346.	PART B/ SECTION- VI	II-E7	6 of 6	5.00.00	The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (Forms & Procedures) and the same shall be considered for the evaluation of the bids.	Our offer includes mandatory type test from HT XLPE Power Cable. Cost of type test for HT XLPE power Cables are included in offer price. No separate charges for type test shall be indicated in Section - VII- (Forms & Procedures) by the bidder.	Technical specification is clear and bidder to comply Technical specification.
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347.	PART B/ SECT ION-VI	II E- 15	4 of 18	3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here.	Illumination of only FGD area in scope are being considered. Please confirm.	Bidder understanding is clear. This is inline with Technical specification.
348.	PART B/ SECT ION-VI	II E- 15	9 of 18	14	In the hazardous areas like Hydrogen generation lighting shall be flameproof	Illumination of only FGD area in scope are being considered. Please confirm.	Bidder understanding is clear. This is inline with Technical specification.
349.	PART B/ SECT ION-VI	II E- 15	11 of 18	4.07.00	Occupancy based Passive Infra-red sensors	Please mention areas where sensors are to be used. As there is no office area, conference rooms etc. in FDG scope so these sensors are not being considered.	Occupancy based Passive Infra-red sensors shall be used in office area, conference rooms etc. in FGD scope area if available.
350.	PART B/ SECT ION-VI	II E- 15	15, 16, 17, 18	Annexure-A,B	Location	Illumination of only FGD area in scope are being considered. Please confirm.	Bidder understanding is clear. This is inline with Technical specification.

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351.	PART B/ SECTION-VI	II-E15	18 OF 18	Annexure-B, DC emergency Lighting	Lux level for DC lighting shall be as below:- Sl. Area Average Lux Level 1 . Unit Control Room -100 2. Control Equipment Room 100 3. Strategic Control Points (In TG Building & Boiler Area, Switchgear room, SWAS, Battery Room, UPS Area, TG Hall, Luboil Room etc.- 20	Lighting level by DC emergency lighting will be provided only to meet functional/ operational requirements. DC fixtures will be located at strategic locations such as near entrance, staircase, landings etc. for safe personnel movement during emergency". Please confirm.	Bidder understanding is clear. This is inline with Technical specification.
352.	PART B/ SECTION-VI	II E-14	1 of 9	2.01.00	Type A fire sealing system in CER & CCR.	Since CER & CCR is not in scope of FGD area, so Type A fire sealing system is not being considered. Only Type B fire sealing system shall be provided. Please confirm.	Please note that Type B fire sealing system shall be provided for control panels and for remaining area's Type A fire sealing shall be used.
353.	PART B/ SECTION-VI	II-E6	15 of 27	5.00.00	Earthing System	Please provide soil resistivity data.	It is bidder scope of works.

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354.	PART B/ SECTION-VI	II-E6	15 of 27	5.01.00	Minimum two nos. of risers shall be provided for each equipment in SG area	Riser shall be provided for equipment in FGD scope only and earthing shall be done for areas in FGD scope. Please confirm.	Bidder understanding is clear. This is inline with Technical specification.
355.	General Layout Plan	-		-	General	a) Kindly indicate the location of existing 33KV tie Switchgear and space for new 220kV bay in plot plan and internal layout of switchgear room for bidder to calculate the length of HT Tie Cable. b) Kindly provide all pipe & cable trestle layouts to establish the feasibility of routing of cables on existing pipe cum cable trestles. c) Customer to furnish Layout of Switch yard control room and layout of any existing switchgear room in switchyard area.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities and space availability etc.

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356.	PART E	-		-	Key SLD General	Kindly provide the Electrical loading of existing 33 kv Switchgear for the bidder to calculate the HT incomer Cable requirement for Tie Feeder.	Bidder to refer Tender SLD for feeder rating of existing switchgear.
357.	PART E	-		-	Key SLD General	From FGD TIE trf #1 &2 and 3 & 4 to 33 kV Tie swgr, Cable or bus duct connection shall be considered as per the feasibility of layout. Please confirm.	NTPC Noted.
358.	General Layout Plan	-		-	General	Kindly indicate the location of FGD TIE trf #1,2, 3 & 4.	Bidder's FGD tie transformers shall be located in switchyard area. Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities and space availability etc.

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359.	Part-B	SUB-SECTION-III-C8 (FGD)	3 OF 4	2.11.00	SIL CERTIFICATION: All actuators shall be certified for SIL 2 or better.	There are only about 2-3 vendors who can offer non-intrusive actuators that are Profibus based and SIL-2 compliant. The SIL-2 compliant actuator models are imported and about 5 times costlier. Considering the initial cost, maintenance as well as spares costs and the indigenous non-availability, bidder request owner to reconsider the SIL-2 certification requirement for actuators.	Bidder's proposal is not acceptable. Bidder to comply the specification requirements.
360.	Sec VI ,Part-B	Sub section- II – E10	11 of 57	4.17.00	All draw-out modules shall be provided with “Closed door operation” feature wherein movement of the module from “Isolated” position to “Service” position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition.	The tender specification calls for Closed-door operation feature. Considering the limited availability of indigenous sources for the same, bidder proposes Form IV-B panels without the closed-door operation feature. Owner may review and confirm.	Bidder is requested to comply the technical specification

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361.	VI, PART -A	SUB-SECTION-I	14 OF 19	3.2.2	Provenness criteria for LT switchgear, ROUTE-1 and ROUTE-2	This clarification is wrt route no.2 for qualification of the sub-vendors for ESP SWG panels. The sub-vendor for LT panels shall use the breakers of NTPC approved make / vendors meeting QR route 1 only. The vendors shall also be meeting the criteria under 3.2.2(i) and 3.2.2 (ii) clauses. Moreover, it is the bidder responsibility to ensure the performance of the supplied equipment. Hence, we request that the clause 3.2.2(iii) regarding association of the sub-vendor and the letter of technical support may be removed . With this , bidder can have more active vendors meeting the qualification criteria . Owner may review and confirm.	Bidder to comply the technical specifications.
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362.	VI/B	II-E-10	11 of 57	4.17.00	All draw-out modules shall be provided with "Closed door operation" feature wherein movement of the module from "Isolated" position to "Service" position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition.	We propose all draw-out modules shall be as per normal conventional design instead of "Closed door operation" feature.	Bidder is requested to comply the technical specification
363.	VI/B	II-E-10	13 of 57	07.03.00	All bus bars and jumper connections shall be high conductivity Aluminum alloy/Copper of adequate size.	We have considered Aluminum Busbar.	Bidder is requested to comply the technical specification
364.	VI/C		5 of 83	7.02.00	It has been indicated that lifting devices to be provided for weight excess of 500 kg but demarcation criteria has not been indicated for electric hoist & manual hoist.	We propose that upto 2 tonnes capacity, manual hoist shall be provided. Electric hoist shall be provided for capacity more than 2 tonnes &/or with lift more than 10 m. Above is inline with clause 4.09.00, part-A, page 10 of 12, section VI, sub section III-A5, LIME STONE & GYPSUM HANDLING PLANT. Kindly accept the same.	Bidder to note that for FGD system other than Limestone and gypsum handling plant, the specification clause referred to be followed

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365.	General				Technical requirements not indicated for electric hoists in air compressor house, ECW pump motor	We propose that electric hoists shall be class 2 duty as per IS 3938. Hoisting speed- 3-5 m/min Travelling speed- 10-15 m/min. Kindly accept the same.	Bidder is requested to refer the SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP) chapter for Hoist specification
366.	TECHNICAL SPECIFICATION SECTION-VI BIDDOC. NO.: CS-0011-109(4)-9 PART	SUB-SECTION-I-M1 (FGD)	6 of 51	3.02.04	In case Kahalgaon St-(4 x 210 MW) projects Absorber bypass duct has been envisaged which shall be designed considering a flow of 40% flue gas entering at the inlet of the FGD system. Bypass duct from the interconnection of the duct which is going to the new wet flue chimney shall be made of Carbon steel of minimum 7mm thickness clad with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / Titanium Gr-II up to a length of 1-2 meter. Quick acting biplane bypass damper in the absorber bypass line shall also be made of Carbon steel of minimum 7mm thickness clad with 2 mm (minimum) thickness Alloy C276 /	Bidder understands that this clause is applicable for Kahalgaon (4x210 MW) only. Employer is requested to confirm on Bidder's understanding.	Bidder understanding is correct.
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	B				Alloy 59 / Titanium Gr-II. Bidder to ensure proper mixing of the treated and untreated flue gas at the duct interconnection and in the downstream duct going to the new chimney.		
367.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:	SUB-SECTION-I-M1 (FGD)	31 of 51	8.04.00	All the slurry pumps shall be provided with motorized suction and discharge valves.	Bidder shall provide motorized / pneumatic suction and discharge valves for slurry pumps as per tender scheme (drawing no. 0011-109(4)-POM-A-001, -002 and -003).	Bidder is quoting a wrong reference. Specification has already been revised. Bidder is requested to refer the specification.
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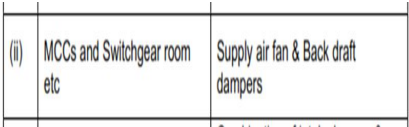
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368.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(4)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	1 of 26	3.01.00	Modular type UAF units of suitable capacity (1x100%) shall be provided for non-air-conditioned area of FGD control room building considering design philosophy for evaporative type ventilation system mentioned in sub sectionV (salient design data and sizing), Part-A of technical specification section VI. All non-air-conditioned area of FGD (cable gallery & MCC room shall be positively ventilated and exhaust shall be through gravity damper).	Employer shall clarify the type of Ventilation (Mechanical Ventilation with Supply air fan and back draft louvre OR Evaporative ventilation with UAF) is required in FGD area control room building non-air-conditioned area. Clauses are contradictory since MCC room and cable gallery room both are coming under non-air-conditioned area of control room building and for that employer is asking for positive ventilation and exhaust through gravity damper (with Supply air fan and back draft dampers) as per clause no. 3.02.00. 	As clearly specified in cl 3.01.00 (i), SUB SECTION-I-M2, Evaporative ventilation with Modular type UAF shall be provided for non-air conditioned areas of FGD control room building (Cable gallery and MCC room etc). For various other areas/buildings having Cable gallery and MCC room shall be provided with mechanical ventilation as per clause 3.02.00, SUB SECTION-I-M2.
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369.	TECHNICAL SPECIFICATION SECTION – VI, PART -A BID DOC. NO.: CS-0011-109(4)-9	SUB-SECTION-III-A1 FGD	7 of 12	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.	Apart from rubber & flake glass lining, Employer has given additional options for different types of tank in Clause no. 10.01.00 & 13.03.07 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART B SUB-SECTION-I-M1 (FGD). Bidder shall consider referred clauses for tank linings.	Bidder understanding is correct
370.	TECHNICAL SPECIFICATION	SUB-SECTION-I-M1 (FGD)	30 of 51	7.08.06	Suction screens shall be installed to protect the pump.	Suction screens are not applicable for Slurry pumps. 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	Bidder is requested to comply the specification requirement
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	SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B					SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART B SUB-SECTION-I-M1 (FGD).	

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371.	SECTION – VI, PART -B	SUB-SECTION-I-M1 FGD	29 of 51	7.07.07 & 7.07.10	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 clarify 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(4)-POM-A-003, Scheme of Gypsum Dewatering System. However Bidder shall furnish the scheme in their bid. 2) As Employer is arranging the Hydrated lime up to lime storage building this point needs to be incorporated in the Terminal Point Chapter (Section-VI, Part-A, Sub-section IV, Terminal Points & Exclusions). 3) Bidder understands that the lime will be manually feed to the Bucket elevator from the lime storage room.	Bidder is requested to refer the tender drawing and specification clause in this regard.
	PART -A	SUB-SECTION-III-A1 FGD	2 of 9	2.06.00			

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372.	SECTION-VI PART -A	SUB-SECTION-VIIM ANDATORY SPARES	5 of 63	1.01.00	Booster fan impeller Liners: 1 sets Booster fan casing liners: 1 set	As there is no liner in booster fan impeller & casing, hence bidder shall not envisage any spares for these items.	Applicability of this item shall be finalized based on main supply.
373.	SECTION-VI PART -A	SUB-SECTION-VII MANDATORY SPARES	8 of 63	1.07.00	Gear box: 1 no. for each type and size of pump	Gear box are not applicable for V-belt driven pumps, hence bidder shall not envisage any spares for the same.	Applicability of this item shall be finalized based on main supply.

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374.	SECTION-VI PART -C	PART - C GENERAL TECHNICAL REQUIREMENTS	42 of 83	30.00.00	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 noise level limit of 90 dB (A) for Limestone Crushers as per clause no. 1.09.00 of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART B SUB-SECTION-I-M1 (FGD). Employer is requested to amend the clause no. 30.00.00 of Part C.	Bidder is requested to refer the Amendment in this regard.
375.	SECTION-VI, PART -B	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	3 of 16	2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 NBC and above as required for periodic observations and inspection purposes.	Bidder has over ground 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 understanding is correct
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376.	SECTION-VI, PART -B	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	4 of 16	2.02.11	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 understanding is correct.
377.	TECHNICAL SPECIFICATION SECTION-VI PART -A	SUB-SECTION-III A1 FGD	5 of 12	5.04.00	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 -Bidder proposes to use process water from process water pump (2x100%) for belt cloth washing, as filtrate may contain solids. Hence,	Process water may be used for the belt and cloth wash. However equipment like tank, pump shall be provided as per the specification requirement. Specification

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378.	TECHNICAL SPECIFICATION SECTION-VI PART -B	SUB-SECTION-I M1 FGD	27 of 51	7.04.07	For cake washing only clarified water shall be used.	separate pump (2x100%) for belt cloth washing is not envisaged.	
379.	TECHNICAL SPECIFICATION SECTION-VI PART -A	SUB-SECTION-VII - MANDATORY SPARES	46 of 63	1.09.00	Lime Feeders	Bidder understands Lime feeder means Limestone Weigh Feeder . Employer is requested to confirm on Bidder's understanding.	Bidder to comply the specification requirement.

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380.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B	SUB-SECTION-I-M1 (FGD)	18 of 51	5.06.06	Adequate number of viewing ports with flushing devices connected to automatically operating washing system shall be delivered at following locations: (i) upstream of 1st stage (ii) between 1st and 2nd stage (iii) downstream of 2nd stage. (iv) downstream of 3rd stage The regular flushing shall be done in a defined time sequence.	This clause is not applicable for Bidders Absorber design. In absorber, the viewing ports are not provided because nothing can be seen from outside as it is complete darkness inside the vessel. Bidder has several WFGD installations having no viewing port on absorber. However, there are access doors mounted on absorber for access and maintenance as required.	Bidder is requested to provide the same. In case it is not feasible it will be reviewed during detail engineering..
381.	TECHNICAL SPECIFICATION NSE	SUB-SECTION-I-M1(FGD)	17 of 51	5.06.06	Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainlesssteel shall be provided at the exit of the absorber.	Bidder request Employer to allow combination of Polysulfone material and stainless steel as an additional option for Mist eliminators.For example, Vanes may be Polysulfone and Slotting Edge/ Side plate etc. may be made of	Bidder is requested to comply the specification requirement.
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	CTIO N- VIBID DOC. NO.: CS- 0011- 109(4))-9 PART B					Stainless Steel.	
382.	TEC HNIC AL SPE CIFIC ATIO N SECT ION- VI BID DOC. NO.: CS- 0011-	SUB- SECT ION- I-M1 (FGD)	27 of 51	7.04.03	The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material.	The entire frame shall not be in contact with gypsum. Hence bidder shall offer Carbon steel frame painted with corrosion resistant paint.	Bidder is requested to comply the specification requirement.
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383.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B	SUB-SECTION-I-M1 (FGD)	29 of 51	7.07.06	The material of Casing and impeller shall be rubber lined Cast Iron (IS:210 Gr FG260). Shaft shall be 410 & Shaft Sleeves shall be of Stainless Steel - 316.	Bidder shall envisage EN8 shaft material for waste water pump, as shaft is not in contact with slurry. However Shaft Sleeves shall be of Stainless Steel - 410.	Bidder is requested to comply the specification requirement.
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384.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B	SUB-SECTION-I-M5 (FGD)	3 of 15	3.01.02	e) Shaft SS-316	Bidder shall envisage EN8 shaft material for ECW system pump, in place of SS316 as there is no physical contact between fluid and Shaft.	Bidder is requested to comply the specification requirement.
385.	TECHNICAL SPECIFICATION	SUB-SECTION-III A1 (FGD)	4 of 12	4.01.08	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves. On/Off type Diaphragm valves in Gypsum	Bidders clarifies the following points: 1. Bidder shall offer Diaphragm actuated Ceramic ball control valve in limestone slurry supply line (going towards absorber) in place of On/off type Diaphragm valve as per bidder's proven practice in past FGD projects.	NTPC Noted.
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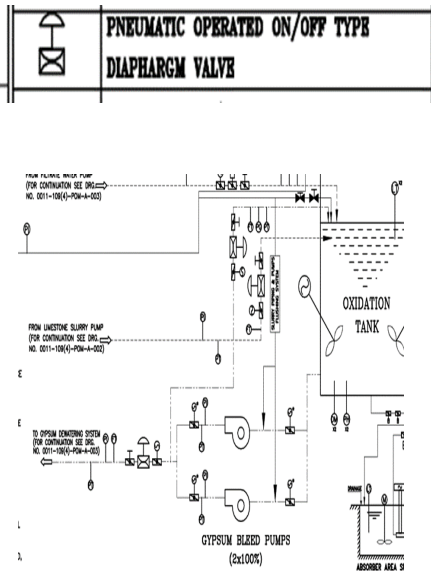
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	SECTION- VI PART -A				circulation lines to be provided instead of pinch control valve.	As limestone slurry feeding to absorber can not be controlled with on/off type Diaphragm valve. 2) In limestone slurry recirculation line	

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386.	TECHNICAL SPECIFICATION SECTION-VI PART-A	SUB-SECTION-III A1 (FGD)	3 of 12	3.01.05	Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves. On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve. 	(return line to limestone slurry tank), Gypsum bleed supply line (going towards dewatering system) & return line (towards absorber), bidder is already providing one manual on/off type butterfly valve and one motorized on/off type butterfly valve for isolation purpose as per tender scheme. Hence bidder shall not envisage any additional On/off type Diaphragm valve for isolation purpose as shown in the tender scheme. Employer is requested to confirm on bidders above consideration.	Bidder is requested to comply the specification requirement.
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387.	TECHNICAL SPECIFICATION SECTION-VI PART-A	SUB-SECTION-III A1 (FGD)	4 of 12	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.	Bidder understands that below are the two options for the type of Oxidation blowers: 1. Single or dual vane centrifugal type blower with fixed speed motor 2. Positive displacement (Helical lobe) type blower with VFD drive Employer is requested to confirm on Bidder's understanding.	Bidder understanding is correct
388.	TECHNICAL SPECIFICATION SECTION-VI PART-A	SUB-SECTION-III A1 (FGD)	7 of 12	8.02.00	The Interior surface of the Sumps shall be lined with FRP lining / PP lining of Minimum 5 mm thickness or Acid Resistant Tiles.	Bidder request Employer to allow " 3 mm thick Vinyl ester based flake glass lining " on the interior surface of the sumps as per bidder's proven practice and same was allowed in all WFGD tenders.	Bidder is requested to comply the specification requirement

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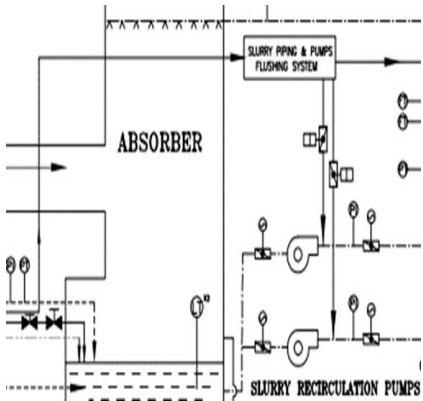
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389.	SECTION-VI PART -A	SUB-SECTION-VIIM AND ATORRY SPARES	1.02.00	6 of 63	Gates in Flue Gas system: 3. Expansion joint: 1 number for each type and size	Expansion joints are not applicable for Gates. Hence, mandatory spares for the same are not envisaged. Employer is requested to confirm on Bidder's understanding.	Bidder is requested to comply the specification requirement
390.	SECTION-VI PART -A	SUB-SECTION-VII MANDATORY SPARES	1.04.00	6 of 63	Absorber Ceramic Liner (including ceramic tiles and all the liner components): 2% of installed liner area	Bidder understand that this clause is applicable only for Ceramic lined Absorber.	Bidder understanding is correct.

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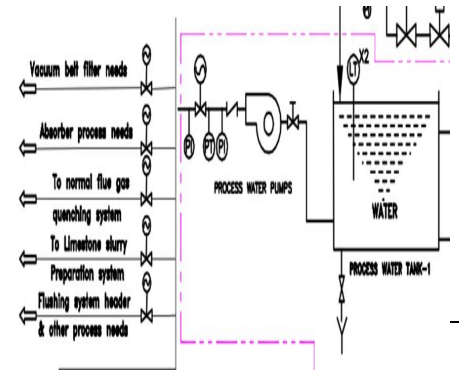
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391.	TECHNICAL SPECIFICATION SECTION – VI, PART -E BID DOC. NO.: CS-0011-109(4)-9	0011-109(4)-POM-A-001	2 of 3			As per clause no. 5.01.00 (iv) of TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(4)-9 PART B SUB-SECTION-I-M1 (FGD), Employer has allowed both options (Pneumatic/motor operated) for valve actuation. However tender scheme indicates only motorized valves. Hence, Bidder has considered type of Valve actuation as per tender clause no. 5.01.00, mentioned above.	Specification has already been revised. Bidder is requested to refer the specification.
392.	TECHNICAL SPECIFICATION SUB-SECTION-I-M1 (FGD)	SUB-SECTION-I-M1 (FGD)	10 of 51	4.03.00	Fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration.	Bidder is considering that the duration of short time excursion temperature of 300 deg C shall be of 15 mins as per cl no. 3.01.00 and not as per cl no. 4.03.00.	Bidder is requested to comply the specification requirement.
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	SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B									
393.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-	SUB-SECTION-I-M1 (FGD)	5 of 51	3.01.00	<table border="1"><tr><td>3.</td><td>Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C)</td><td>300</td></tr></table>	3.	Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C)	300		Specification requirement is clear. Bidder is requested to comply the specification requirement.
3.	Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C)	300								
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	0011-109(4)-9 PART B						
394.	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(4)-9 PART B	SUB-SECTION-I-M1 (FGD)	28 of 51	7.06.02	2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter.	Bidder shall not envisage separate pumps for belt washing. Same shall be provided from Process water tanks through Process water pumps, as per Tender scheme. 	Bidder is requested to comply the specification requirement.
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395.	CS-0011-109(4)-9	I-M1	10	4.02.01	Both fans shall operate with highest possible efficiency which shall be nearly equal at the Guarantee point flow and test block points.	As per specification, fan model will be selected considering 44% margin over calculated pressure and 20% margin over fan sizing flow. In this scenario, it is not possible to get highest efficiency both for TMCR and Test Block condition considering other parameters as per specification.	Now in this project there is no additional requirement of De-Nox system margin. Hence, Bidder is requested to comply the specification requirement.
396.	CS-0011-109(4)-9	I-M1	9	4.01.02 (iv)	Bidder shall consider the margin over pressure requirement as 44% over the calculated head value excluding the static head.	Customer is requested to reconsider the 44% margin on pressure for fan sizing as absorber pressure drop is not directly proportional to square of velocity. As a result, fan model will be bigger than requirement resulting in lower efficiency in TMCR condition.	Bidder is requested to comply the specification requirement.
397.	VI / B	IV-D	28 of 67	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	Bidder wish to inform that, as per tender specification the design of steel structure shall be done as per IS standard. Employer has given the	Bidder to provide Special moment resisting steel frames only as per the Technical Specification

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398.	VI / A	II-A5	5 of 32	Rihand Project Information (Appendix1)	Site Specific Seismic parameters for Design of Structures & Equipment :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 : 0.048	Seismic parameter only for Special moment resisting steel frames which is 0.048, however Employer has not given the Seismic parameter for Ordinary moment resisting steel frame . So Bidder request Employer to furnish the project specific values for both Special moment & Ordinary moment resisting steel frame for all Lot 4 projects.	provisions.
399.	VI/E	DRA WIN G : 0011-109(3)- POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		SO2 Analyser and Flow measurement at Absorber outlet duct	Based of bidder experience, measured values for SO2 & gas flow at Absorber out let duct is not reliable due to multiple transitions/bends between absorber outlet duct and wet stack. Hence, measurement of SO2 and flow at absorber outlet duct shall not be envisaged. Further, these parameters are monitored by CEMS in wet stack (absorber outlet & new wet stack is in same process stream) provided by Bidder. Hence additional SO2 & flow measurement at Absorber outlet is not	Bidder is requested to refer the amendments in this regard.
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						envisaged. Employer to confirm Bidder's consideration.	
400.	VI/E	DRAWING : 0011-109(3)-POM-A-001, Scheme of Absorber	1 OF 3 2 OF 3 3 OF 3		Schemes shows DPT with DPI across ME in Absorber.	Bidder 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.

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401.	VI/E	DRAWING : 0011-109(3)-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.

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402.	VI/E	DRA WIN G : 0011-109(3)-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.
403.	VI/E	DRA WIN G : 0011-109(3)-POM-A-001, Sche	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.
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		me of Absorber					
404.	VI/A	III-C (C&I SYSTEM)	17 OF 21	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.
405.	VI/A	III-C (C&I SYSTEM)	2 OF 21	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).	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.
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						Employer to confirm on Bidders understanding.	
406.	VI/A	III-C (C&I SYST EM)	2 OF 21	1.02.01	Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications except for Booster Fan blade pitch controls for which conventional controls and devices (Actuators, Instruments) shall be provided	Bidder understand that all field transmitters (PT/DPT/TT) and motorized actuators except Booster fan blade pitch actuator and instrumentation shall be fieldbus (FF/Profibus-PA) based instruments. In addition 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.

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407.	VI/A	III-C (C&I SYST EM) & III-C8 (ELE CTRI C ACT UAT ORS)	3 OF 21 of III-C (C&I SYSTE M) & 3 OF 4 of III-C8 (ELECT RIC ACTUA TORS)	1.02.01 (E) & 2.11.00	For High torque (> 1000 Nm) electric actuators: Contractor may propose nonintrusive fieldbus electrical actuators without SIL2 certification. All actuators shall be certified for SIL 2 or better	Bidder understand, SIL 2 exemption shall be considered for higher torque electrical actuators, However based on bidder experience FGD system shall not required SIL-2 certification and request to provide all electric actuators without SIL-2. Employer to confirm on Bidders understanding.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
408.	VI/A	III-C (C&I SYST EM)	11 OF 21	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.

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409.	VI/A	III-C (C&I SYST EM)	16 OF 21	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).
410.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYST	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 1 OF 3	1.03.00	FGUTPP-(2 X 210 MW) <u>PROCESS WATER</u> Shall be tapped from clarified water tank of FGUTPP ST-I	During site visit, Bidder could not find the location of clarified water tank/header for Stage I. Hence, Bidder request Employer to furnish the Terminal Point coordinate/grid name of "existing clarified water tank/header" and markup this TP in the layout drawing. Bidder wishes customer to specify available supply pressure from clarified tank/header. Is there any requirement of booster pump to meet the flow requirement.	Bidder to refer the amendment in this regard.
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	EM PAC KAG E/SE CTIO N – VI, PART -A BID DOC. NO.: CS- 0011- 109(2) -9						

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411.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE/SECTION – VI, PART-A BID DOC. NO.:	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 1 OF 3	1.03.00	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW) <u>PROCESS WATER</u> Shall be tapped from CW Blowdown from the existing blow down header of stage-II & III available nearest to the FGD area. <u>Gypsum wash water</u> Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III	During site visit, Bidder could not find the location of existing blow down header of stage- II & III. Bidder request Employer to furnish the Terminal Point coordinate/grid name of "existing blow down header of stage- II & III" and markup this TP in the layout drawing. Bidder wishes customer to specify available supply pressure from existing blow down header of stage- II & III . Is there any requirement of booster pump to meet the flow requirement. Bidder wishes customer to specify available supply pressure from existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III. Is there any requirement of booster pump to meet the flow requirement.	Bidder to refer the amendment in this regard.
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412.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD)	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 1 OF 3	1.03.00	<u>Emergency makeup to ECW tank</u> 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 normal	Bidder wishes customer to specify available supply pressure of Emergency make up water for all projects.	Bidder to refer the amendment in this regard.
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	SYST EM PAC KAG E/SE CTIO N – VI, PART -A BID DOC. NO.: CS- 0011- 109(2) -9						

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413.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE/SECTION - VI, PART -A BID DOC. NO.:	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 1 OF 3	1.03.00	<u>Normal makeup to ECW tank</u> Contractor shall take a tap off suitably from the existing DM Emergency make up header (condensate transfer pump discharge) available near Crow for meeting the emergency make up water requirement	Bidder wishes customer to specify available supply pressure of DM water for all projects.	Bidder to refer the amendment in this regard.
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414.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM	SUB-SECTION- TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.03.00	<u>Process Water & Gypsum Wash Water (Clarified water)</u> Tap off suitably from clarified water tank of Singrauli-I &II	During site visit, Bidder could not find the location of clarified water tank/ header for Stage I & II. Hence, Bidder request Employer to furnish the Terminal Point coordinate/grid name of "existing clarified water tank/ header" and markup this TP in the layout drawing. Bidder wishes customer to specify available pressure in existing clarified water tank/ header	Bidder to refer the amendment in this regard.
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	PAC KAG E/SECTION – VI, PART -ABID DOC. NO.: CS-0011-109(2)-9						
415.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD)	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.03.00	<u>Process Water & Gypsum Wash Water (Clarified water)</u> Tap off suitably from clarified water tank of Rihand stage-II	During site visit, NTPC site representative informed that "Clarified water tank" is not available at site . However, they informed that tapping can be taken from clarified water header going to DM plant. Hence, Bidder request Employer to furnish the Terminal Point coordinate/grid name of "existing clarified water tank/header" and mark this TP in tender GLP.	Bidder to refer the amendment in this regard.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 189 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			

	) SYST EM PAC KAG E/SE CTIO N – VI, PART -A BID DOC. NO.: CS- 0011- 109(2) -9					Bidder wishes customer to specify available pressure in existing clarified water tank/header	

LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	CLARIFICATION NO. CS-0011- 109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 190 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
416.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE/SECTION – VI, PART-A BID DOC. NO.:	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	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 FGD area.	Bidder wishes customer to specify available supply pressure of Portable water at customer TP location for all projects.	The pressure available at TP will be 2.2 Ksc (gauge) wrt FGL (approx.).
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 191 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	CS-0011-109(2)-9						
417.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.08.00	Waste FGD waste water and LHP/GHP waste water shall be sent to ash slurry sump. Lime neutralization of FGD waste water shall be done before sending it to ash slurry sump.	Water is used in LHP/GHP area, only for floor/ equipment cleaning purpose during maintenance & this water shall be discharged to nearest drain/ sump. There is no generation of waste water from LHP/GHP equipments. However, FGD waste water shall be sent to ash slurry sump after lime neutralization.	Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 192 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	PAC KAG E/SECTION – VI, PART -A BID DOC. NO.: CS-0011-109(2)-9						
418.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION	PART -A SUB-SECTION-III SCOPE OF SUPPLY	PAGE 5 OF 6	1.11.00	Existing Pipe /cable trestles, conveyors etc. passing through the proposed FGD area shall be retained, and FGD layout shall be prepared accordingly.	Bidder wishes customer to allow use of existing pipe & cable trestle for routing of pipes from terminal points to FGD area.	Existing pipe racks shall not be used for routing pipes related to FGD system. Bidder to comply with Technical Specification.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 193 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAU SE NO.			
	(FGD) SYST EM PAC KAG E/TE CHNI CAL SPE CIFIC ATIO N SECT ION- VI BID DOC UME NT NO.: CS- 0011- 109(4)) -9	& SER VICE S					

LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 194 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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419.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	Page 18 of 74	4.13.2	<u>Service Water and cooling Water System</u> Service water and Cooling water distribution system (for scoop coupling) complete with water supply system, valves, quick couplings, hose pipes with nozzle, piping, pumps, drive motors with canopy, couplings with enclosure, electricals, including supporting structures, handling for equipment's, civil and structural works and necessary accessories shall be provided throughout the limestone handling system.	Bidder understands the same Process water or Clarified water as supplied for Process water / ECW /Gypsum wash water is used for service water in LHS & GHS. Bidder also understands there is no separate terminal point for supply of service water. Bidder wishes customer to specify source of Service water used in LHS & GHS if water used is different from Process water.	Bidder understanding is in order, Source shall be in line with specification requirement mentioned in chapter terminal points and Exclusions.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 195 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	VI, PART -B BID DOC. No.C S-0011-109(4)-9						
420.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM	SUB-SECTION-I-M7 (LOW PRESSURE PIPING)	PAGE 2 OF 16	1.05.00	Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.	Bidder understands that this is applicable for all slurry as well as water and air conveying pipes in FGD except air-conditioning & ventilation system and fire fighting system for which minimum thickness are mentioned in Annexure - I and Annexure -II. Pipe thickness shall be selected based on calculation as per pressure requirement .	Bidder understanding is correct
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 196 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			

	PAC KAG E/TE CHNI CAL SPE CIFIC ATIO N SECT ION- VI, PART -B BID DOC NO.: CS- 0011- 109(4) -9						

LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 197 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
421.	LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE/TECHNICAL SPECIFICATION SECTION-	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)	Page 44 of 74	3.3.5	Materials for Pipework (a) For sizes 200 NB and Larger ERW carbon steel pipes to API-5LGr.B/IS:3589 with minimum thickness 6.35 mm	Bidder understands that this minimum pipe thickness 6.35mm is only applicable to Limestone and gypsum handling plant piping systems for pipe sizes 200NB and larger.	Bidders under standing is in order. However, bidder to provide minimum thickness of 6.35 mm for specified pipes of 200 NB and above and also justify the thickness of selected pipe through calculation during detail Engineering.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 198 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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	VI, PART -B BID DOC. No.C S-0011-109(4)-9						
422.	SECTION – VI, PART -A	SUB SECTION-II-A4 PROJECT INFORMATION (SINGRAULI I&II (5X20	2 OF 31	1.04.00	(ii) Process water: Process water quality is CW Blowdown based on the COC indicated in Table-4.	Bidder understands that clarified water is to be used as process water. Only source of water is clarified water which is to be used as Process water and cake wash water.	Bidder is requested to comply the specification
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 199 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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		0 & 2X50 0MW)					
423.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.08.00	Waste Water	Bidder request employer to provide the required pH and pressure of waste water at the terminal point.	Waste water PH and pressure value is bidder specific. Based on the process requirement Bidder is requested to derive the value. However, Waste water quantity is indicated in the specification.
424.	SECTION – VI, PART -B	SUB-SECTION-I-M1	29 of 51	7.07.06	2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the		Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 200 of 364

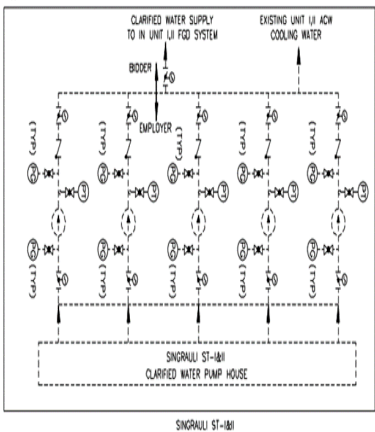
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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					Technical Specification.		
425.	SECTION – VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	PAGE 2 OF 3	1.03.00 Equipment Cooling Water	8 Singrauli-I (5 x200 MW) Tap off suitably from clarified water tank of Singrauli-I. 9 Singrauli-II (2 x500 MW) Tap off suitably from clarified water tank of Singrauli-II.	As per tender drawing no. 0011-109(4)-POM-A-004, the terminal point for Equipment cooling water is at the existing Clarified water pump discharge header , whereas in terminal point it is mentioned from clarified water tank of St-I &II . Employer to clarify the exact terminal point (header or Tank).	Bidder to refer the amendment in this regard.

LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 201 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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426.	SECTION-VI, PART -E			tender drawing no. 0011-109(4)-POM-A-004,			
427.	SECTION – VI, PART -A	SUB-SECTION-III-A1	6 of 12	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.	Bidder understands that 1 (one) no. common auxiliary absorbent tank is to be provided for all the FGD units (5x200 MW + 2x500 MW) of Singrauli. Employer to confirm on bidder's understanding.	Bidder understanding is correct.
428.	SECTION – VI, PART -A	SUB-SECTION-III-A1	2 of 12	2.07.00	A common auxiliary absorbent tank shall be provided for storage of absorber slurry of one absorber (maximum capacity) along with slurry pumps for pumping the slurry back to any of the absorber		Bidder understanding is correct
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 202 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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429.	VI/B	SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS	18 OF 51	5.06.07	The absorbtion tank shall be provided with an overflow line complete with sealing pot.....	Seal loop shall be provided as per Bidder's proven practice	Bidder is requested to comply the specification requirement
430.	VI/A	SUB SECTION – V, SALIENT DESIGN DATA	1-10 of 23	Sl. No. 5 under, 2.00.00, A 2.00.00, B 3.00.00 A, 3.00.00 B 3.00.00 C	Gas Flow (Nm3/s) and Gas Flow (m3/s)	The gas flow in Nm3/s is not matching with the given corresponding gas flow in m3/s for both guarantee & design conditions in all Lot 3 projects. Please clarify.	Nm3/s gas flow may be considered.

**LOT-4 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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431.	VI/A	SUB SECTION - II-A5, PROJECT INFORMATION - RIHAND	28 of 32	Table Note 4,	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.	Bidder understands that only source of water is clarified water from Clarified water tank which is to be used for both as Process water and cake wash water. The note below Table 4 is not relevant for this project.	Bidder is requested to comply the specification requirement.
432.	VI/A	SUB-SECTION-I-M6 LIMESTONE AND GYPSUM HANDLING PLAN	Page 6 of 41	4.13.5	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.	Bidder understanding is in order, Source shall be in line with specification requirement mentioned in chapter terminal points and Exclusions.
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY																																																			
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.																																																						
433.	1148	VI/B	I-M5	15 of 15	<u>Annexure-II</u> <table><tr><th colspan="3">Annexure-II</th></tr><tr><th colspan="3">Maximum Auxiliary (Secondary) water available:-</th></tr><tr><th>Sl. No</th><th>Project</th><th>Maximum water available (cum/hr)</th></tr><tr><td>1</td><td>FGUTPP STAGE-I,II & III</td><td>265</td></tr><tr><td>2</td><td>KAHALGAON STPP STAGE-I & II</td><td>365</td></tr><tr><td>3</td><td>FARAKKA STPP</td><td></td></tr><tr><td></td><td>A) ST-I (3X200MW)</td><td>A) 160</td></tr><tr><td></td><td>B) ST-II(2X500MW)</td><td>B) 265</td></tr><tr><td></td><td>C)ST-III(1X500)</td><td>C) 125</td></tr><tr><td>4</td><td>SINGRAULI STPP</td><td></td></tr><tr><td></td><td>A) ST-I(5X200MW)</td><td>A) 265</td></tr><tr><td></td><td>B) ST-II (2 X500 MW)</td><td>B) 265</td></tr><tr><td>5</td><td>RIHAND STPP-I (2 X500 MW)</td><td>265</td></tr></table> System for each stages of each projects shall be designed separately with considering actual requirement of water corresponding to design points mentioned in the equipment cooling water system specification. <table><tr><th>Sl No</th><th>Project / Stage</th><th>Process water</th><th>Gypsum Wash Water (Clarified Water)</th></tr><tr><td>1</td><td>FGUTPP-I (2 X 210 MW)</td><td>Shall be tapped from clarified water tank of FGUTPP ST-I.</td><td></td></tr><tr><td>2</td><td>FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)</td><td>Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.</td><td>Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.</td></tr></table>	Annexure-II			Maximum Auxiliary (Secondary) water available:-			Sl. No	Project	Maximum water available (cum/hr)	1	FGUTPP STAGE-I,II & III	265	2	KAHALGAON STPP STAGE-I & II	365	3	FARAKKA STPP			A) ST-I (3X200MW)	A) 160		B) ST-II(2X500MW)	B) 265		C)ST-III(1X500)	C) 125	4	SINGRAULI STPP			A) ST-I(5X200MW)	A) 265		B) ST-II (2 X500 MW)	B) 265	5	RIHAND STPP-I (2 X500 MW)	265	Sl No	Project / Stage	Process water	Gypsum Wash Water (Clarified Water)	1	FGUTPP-I (2 X 210 MW)	Shall be tapped from clarified water tank of FGUTPP ST-I.		2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)	Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.	Bidder need following clarifications : <u>1. Unchahar (Stage - I, II & III):</u> As per Terminal point, Employer is providing process & clarified water from 3 different sources (Clarified water tank of stage-I + CWBD of stage II & III + HVAC header (make pump discharge of stage II /III). Bidder understands that 265 m3/hr is combination of water from Clarified water tank of stage-I and CWBD of stage II / III. Employer to furnish the breakup for water available at these 2 terminal points (i.e. breakup of 265 m3/hr) enabling bidder to calculate the pup & pipe sizing & for chloride balance as the quality of water is different. Bidder understands that available quantity of water indicated in the specification (265 m3/hr) is corresponding to Guarantee point only as per clause 3.00.00 A & 3.00.00 C of SUB-SECTION-V,	Bidder to refer the amendment in this regard.
					Annexure-II																																																					
Maximum Auxiliary (Secondary) water available:-																																																										
Sl. No	Project	Maximum water available (cum/hr)																																																								
1	FGUTPP STAGE-I,II & III	265																																																								
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	B) ST-II(2X500MW)	B) 265																																																								
	C)ST-III(1X500)	C) 125																																																								
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	A) ST-I(5X200MW)	A) 265																																																								
	B) ST-II (2 X500 MW)	B) 265																																																								
5	RIHAND STPP-I (2 X500 MW)	265																																																								
Sl No	Project / Stage	Process water	Gypsum Wash Water (Clarified Water)																																																							
1	FGUTPP-I (2 X 210 MW)	Shall be tapped from clarified water tank of FGUTPP ST-I.																																																								
2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)	Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.																																																							
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE					CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 206 of 364																																																				

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

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						SALIENT DESIGN DATA of TECHNICAL SPECIFICATION SECTION – VI, PART-A. Further, water from HVAC header (make pump discharge of stage II /III)) shall be used only for Gypsum cake wash & quantity available at this Terminal point is 0.015m3/hr/ MW. which in addition to 265 m3/hr Employer to confirm on bidder's above understanding/ consideration.	
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 207 of 364

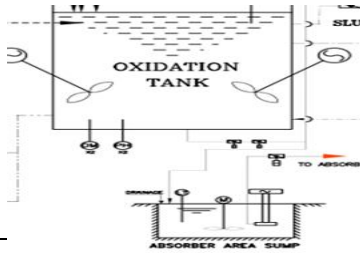
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
434.	1148	VI/B	I-M5	15 of 15		Bidder need following clarifications : <u>1. Singrauli (Stage I & II)</u> Bidder understands that available quantity of water indicated in the specification (265 m3/hr for Stage I 5x200 MW) is corresponding to Guarantee point only as per clause 3.00.00 A & 3.00.00 C of SUB-SECTION-V, SALIENT DESIGN DATA of TECHNICAL SPECIFICATION SECTION – VI, PART-A.	
435.	PART -B	SUB SECTION-IM1	22 of 49	6.05.01	Wet Ball Mill vi). Limestone bond index (kWh/sh.T) : 13 (min)	Bidder Under stand following: Limestone bond index (kWh/sh.T) : 13 (maximum)	Bidder is requested to comply the specification requirement
436.	PART -B	SUB SECTION-IM1	27 of 51	~~7.04.07~~	For this purpose, one (1) clarified water storage tank (minimum 1 hr storage) shall be provided along with 2x100 cake washing pumps for each Vacuum Belt Filter .	For Rihand & Singrauli, there is single source of water (i.e. clarified water), which will be used as process water & Gypsum cake wash water. Clarified water from process water tank shall be used for Gypsum Cake washing. Hence, in these projects bidder shall not envisage any additional Cake wash pump & tank.	Bidder is requested to comply the specification requirement
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437.	Part-A	SUB SECTION-VII	6 of 63	1.04.00	1. Absorber Spray /--- nozzles -- 10% of each type and size	Bidder understands that total 10% of absorber slurry spray nozzles shall be provided by bidder, as spare nozzles..	Bidder is requested to comply the specification requirement.
438.	PART -B	SUB SECTION-IM1	14 of 51	5.01.00 (A)	V) Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level.		Bidder is requested to comply the specification requirement.
439.	Part-A	SUB SECTION-III A5	4 of 12	2.01.12	The capacity of limestone storage silos shall be sufficient to cater the seven day consumption requirement of each unit or group of units for which common FGD facilities has been proposed, however capacity of each silo should not be more than 2000 MT.	Both clauses are contradictory. Limestone storage silos shall be designed to cater total seven (7) day consumption requirement of all the FGD units for which common FGD facilities are provided, as per clause no. 2.01.12.	Bidder to provide lime stone storage silos for 7 days requirement of lime stone storage(with adequate air space) subjected to maximum capacity of an individual silo 2000 MT accordingly number of silo can be decided.
440.	PART -B	SUB SECTION-IM6	73 of 74	4.23.00	Each Silo is to be designed for 7 days retaining capacity of material with adequate air space with maximum capacity limitation up to 2000MT .		
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441.	PART -B	SUB SECTION-IM1	30 of 51	7.08.01	Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.	Bidder shall provide isolation drain valves (normally closed) at bottom of absorber reaction tank which will be opened during draining out of the remaining slurry from absorber reaction tank to absorber area sump as shown in tender scheme (drawing no. 0011-109(2)-POM-A-001, -002 and -003). Portable pumps shall not be envisaged as same is not a proven practice at all. 	Bidder is requested to comply the specification requirement

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442.	VI/A, E	Sub-Section-III-B Electrical System/Equipment	2 of 13	1.05.01 & SLD ((0011-109(4)-POE-J-001/E, Rev B)	i) The scope of work shall include Design, supply, erection, testing and commissioning of one number 220kV bay in FGUTPP STPP-I,II, III for feeding the FGD Tie Transformer, as per the tender SLD (0011-109(4)-POE-J-001/C, Rev: A associated with FGUTPP STPP Stage-I,II & III. The scope also include extension of existing 220kV bus in space adjacent to existing bay#1A. Existing 1 Nos. Transformer for Solar to be replaced with new 50 MVA Trf.	Bidder clarifies following points: 1) Bidder understood that New Transformer Bay shall be as per Tender SLD "0011-109(4)-POE-J-001/E, Rev B" 2) Bidder understood that existing Solar transformers foundation (Bay No. 5) shall be used for new FGD TIE Transformers and same foundation should take new FGD TIE Transformers load. Employer to confirm. 3) Bidder request to Employer please provide the GA & Foundation drawings of existing transformers. 4) Bidder understood that modification shall be limited related to New FGD TIE Transformer's clamps & connectors, hard ware, conductor only (if any requirement). however any modification /replacement of switchyard equipment's (like CT, PT,	1) Bidder understanding is correct. Bidder to refer to Tender SLD "0011-109(4)-POE-J-001/E, Rev B, (Electrical Single line diagram for FGD package FGUTPP STPP-1, II & III) 2) Bidder may refer Clause 1.17.00 of Sub-Section IIIB, Part-A, Section VI of technical specification in this regard. 3) Same shall be provided during detailed engineering. 4) Bidder to refer to Clause no: 1.17.00, FGUTPP Stage-i,ii,III . For existing FGD Tie Transformer #2 bay , regarding the equipments bidder understanding is correct. For FGD Tie Transformer
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						LA, Isolator, CB, etc.) of existing transformer bay is not envisaged. Employer to confirm. 5) Transformer rating shall be considered as per tender SLD. Employer to confirm bidders consideration.	#1 bay, the design, supply, erection of bay is in the scope of bidder . 5) Bidder' understanding is correct. Bidder may further refer Note-4 of Tender SLD in this regard.

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443.	VI/A	Sub-Section-III-B Electrical System/Equipment	2 of 13	1.05.01	ii) Scope of Work shall also include modification as required at FGUTP STPP Stage-I, II & III Switchyard Control Room.	1) Bidder request employer to provide the existing FGUTP STPP Stage-I, II & III Switchyard Control Room details drawing. 2) 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.	
444.	VI/A	Sub-Section-III-B Electrical System/Equipment	2 of 13	1.05.01	iii) 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 Understanding is not correct. For new 220KV bay the Lightning protection & Lighting is in the scope of Bidder. Bidder to provide accordingly.

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445.	VI/A, E	Sub-Section-III-B Electrical System/Equipment	3 of 13	1.05.04 & SLD ((0011-109(4)-POE-J-001/C, Rev B)	i) The scope of work shall include any requirement of clamps & connectors, hard ware, conductors etc. if required (as decided during detailed engg.) in existing 132KV Bay for feeding FGD Tie Transformer#1Replacement of existing transformers with New FGD TIE Transformers....	Bidder clarifies following points: 1) Bidder understood that existing transformers foundation shall be used for new FGD TIE Transformers and same foundation should take new FGD TIE Transformers load. Employer to confirm. 2) Bidder request to Employer please provide the GA & Foundation drawings of existing transformers. 3) Bidder understood that modification shall be limited related to New FGD TIE Transformer's clamps & connectors, hard ware, conductor only (if any requirement). however any modification /replacement of switchyard equipment's (like CT, PT, LA, Isolator, CB, etc.) of existing transformer bay is not envisaged. Employer to confirm. 4)Transformer rating shall be considered as per tender SLD.Employer to confirm bidders	1),Bidder may refer Clause 1.17.00 of Sub-Section IIIB, Part-A, Section VI of technical specification in this regard. 2) Same shall be provided during detailed engineering. 3)Bidder understanding is correct. 4) Bidder' understanding is correct. Bidder may further refer Note-4 of
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						consideration.	Tender SLD in this regard.
446.	VI/A, E	Sub-Section-III-B Electrical System	4 of 13	1.05.06 & SLD ((0011-109(4)-POE-J-001/C Rev	The scope of work shall include any requirement of clamps & connectors, hard ware, conductor etc. if required (as decided during detailed engineering) in existing 132KV bays to match with the FGD Tie Transformers	Bidder clarifies following points: 1) Bidder understood that existing transformers foundation shall be used for new FGD TIE Transformers and same foundation should take new FGD TIE Transformers load. Employer to confirm.	1),Bidder may refer Clause 1.17.00 of Sub-Section IIIB, Part-A, Section VI of technical specification in this regard.
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		m/Equipment		B)	Replacement of existing transformers with New FGD TIE Transformers....	2) Bidder request to Employer please provide the GA & Foundation drawings of existing transformers. 3) Bidder understood that modification shall be limited related to New FGD TIE Transformer's clamps & connectors, hard ware, conductor only (if any requirement). however any modification /replacement of switchyard equipment's (like CT, PT, LA, Isolator, CB, etc.) of existing transformer bay is not envisaged. Employer to confirm. 4) Transformer rating shall be considered as per SLD. Kindly confirm. Employer to confirm bidders consideration.	2) Same shall be provided during detailed engineering. 3) Bidder understanding is correct. 4) Bidder' understanding is correct. Bidder may further refer Note-4 of Tender SLD in this regard.
447.	VI/A, E	Sub-Section-III-B	5 of 13	1.05.07 & SLD ((0011-	The scope of work shall include any requirement of clamps & connectors, hard ware, conductor etc. if required (as decided during detailed	Bidder clarifies following points: 1) Bidder understood that existing transformers foundation shall be used	1), Bidder may refer Clause 1.17.00 of Sub-Section IIIB, Part-A, Section VI of technical
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		Electrical System/Equipment		109(4)-POE-J-001/C Rev B)	engineering) in existing 132KV bays to match with the FGD Tie Transformers Replacement of existing transformers with New FGD TIE Transformers....	for new FGD TIE Transformers and same foundation should take new FGD TIE Transformers load. Employer to confirm. 2) Bidder request to Employer please provide the GA & Foundation drawings of existing transformers. 3) Bidder understood that modification shall be limited related to New FGD TIE Transformer's clamps & connectors, hard ware, conductor only (if any requirement). however any modification /replacement of switchyard equipment's (like CT, PT, LA, Isolator, CB, etc.) of existing transformer bay is not envisaged. Employer to confirm. 4) Transformer rating shall be considered as per tender SLD. Employer to confirm bidders consideration.	specification in this regard. 2) Same shall be provided during detailed engineering. 3) Bidder understanding is correct. 4) Bidder' understanding is correct. Bidder may further refer Note-4 of Tender SLD in this regard.
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448.	VI/A	Sub-Section-III-B Electrical System/Equipment	5 of 13	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. Approved make list (if any) for Relay testing kits. 3. Details of existing Relay Engineering network.	1. Bidder to Refer to Part-B, Chapter-E-20. 2) Bidder to refer to Indicative Vendor list for electrical items in Part-B, Chapter-QA 3)The details shall be provided during detailed engineering on award of contract.
449.	VI/A	Sub-Section-III-B Electrical System/Equipment	5 of 13	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.	The details shall be provided during detailed Enggengineering on award of contract.
450.	VI/A	Sub-Section-III-B Electrical	5 of 13	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 under standing is correct. Owner will provide the terminals / terminal points of PTs connection. Required cabling, interfacing with
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		System/Equipment					existing system is in the scope of Bidder.
451.	VI/A	Sub-Section-III-B Electrical System/Equipment	6 of 13	1.06.00 (B)	Bidder shall check the existing protection system and provide additional protections if required with respect to tender SLD. New Protection system shall be provided with Numerical relays and must comply with the NTPC Technical specification. Relay protection panels for new relays, integration with existing SOE (sequence of event) system, Relay test kit as per specification	Bidder request to employer to furnish the following details:1. Detail list of existing protection system.2. Detail list of existing SOE (sequence of event) system.3. Detail list of Relay test kit.Bidder understood that any additional protections (Numerical relays) if required, the same shall be placed in existing Relay control panel. Employer to confirm.	1),2)-The details shall be provided during detailed engineering on award of contract. 3) Bidder to Refer to Part-B, Chapter-E-20. Bidder to refer to Indicative. Vendor list for electrical items in Part-B, Chapter-QA . 4)Bidder understanding is not correct. Bidder to provide relay protection panel for new relays.
452.	V/B	SUB SECTION-II-E12 TRA	1 of 21	1.01.00	Tap changer	Bidder request to Employer to indicate the Type of tap changer, tapping range with steps, location of tap changer, type of variation. And also request to share the Sub section B-0	Bidder is requested to refer the amendment in this regard
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		NSF ORM ERS/ REA CTO R				for further details as mentioned in tender specification.	
453.	V/B	SUB SECT ION-II-E12 TRA NSF ORM ERS/ REA CTO R	1 of 21	1.01.00	Impedance	Bidder request to Employer to indicate the Impedance value at principal tap. Bidder request to Employer any requirement of parallel operation of FGD TIE Transformers, if yes please provide the details. And also request to share the Sub section B-0, B-04 for further details as mentioned in tender specification.	Impedance for LT transformers is indicated in Tender SLD. Bidder may further refer amendment in this regard.
454.	V/B	SUB SECT ION-II-E12 TRA NSF ORM ERS/ REA	1 of 21	1.01.00	Termination, SC withstand time & fault level.	Bidder request to Employer to indicate the Termination, SC withstand time & fault level details. And also request to share the Sub section B-0 for further details as mentioned in tender specification.	Bidder may refer Tender SLD & Sub-section-E1. Further, Bidder to further refer amendment in this regard.
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		CTO R					
455.	VI/B	SUB SECTION-II-E12 TRANSFORMERS/ REACTOR	2 of 21	1.03.01	The number and capacity of cooling fans with radiator bank shall be such that outage of any fan does not reduce the continuous rating.	Bidder considered outage of any one fan does not reduce the continuous rating. Please confirm	NTPC Noted
456.	VI/B	SUB SECTION-II-E12 TRANSFORMERS/ REACTOR	3 of 21	1.04.01	The main tank body including tap changer, radiators (except for Auxiliary transformers) and coolers shall be capable of withstanding full vacuum.	Bidder wish to clarify that, Main Tank Body shall be as per CBIP. Employer to confirm	Bidder is requested to comply the specification requirement.
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457.	VI/B	SUB SECTION-II-E12 TRANSFORMERS/ REACTOR	5 of 21	1.04.07	Bushing CT's	Bidder shall be considered only WTI CT's, Employer to confirm any protection CT requirement.	Bidder may refer Sub-Section IIE-20, Part-B, Section-VI of Technical specification in this regard.
458.	VI/B	SUB-SECTION II-E-20 CONTROL AND PROTECT	General		General	Bidder shall be considered DISTURBANCE RECORDER, EVENT LOGGER AND FAULT LOCATOR ARE AS IN-BUILT FUNCTION OF THE NUMERICAL RELAYS. STANDALONE EQUIPMENT ARE NOT CONSIDERED FOR THESE APPLICATIONS.	Bidder understanding is correct
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459.	VI/B	SUB-SECTION II-E-20 CONTROL AND PROTECTION	3 of 20	4.00.00	Provision for interfacing with owners PI (Plant Information) system on OPC (if applicable):	Bidder doesn't envisage any requirement of Provision for interfacing with owner's PI (Plant Information) system on OPC. Please confirm.	Configuration for New switchyard bays as per the tender SLD/ specification for interface with owners PI system on OPC where ever existing shall be in the scope of the Bidder.
460.	VI/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.	Bidder is requested to comply the specification requirement
461.	VI/B	II-E2 MOTORS	4 of 9	7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for	Bidder shall provide phase segregated type terminal box (PSTB) with a fault level of 43kA for 0.25sec.	Bidder is requested to comply the specification requirement.
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					0.17 seconds.		
462.	VI/B	SUB SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	6 of 8	2.08.00	DG set(s) shall be capable of meeting 100 % of essential load requirements of FGD System including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop.	Both clauses are contradictory to each other. Bidder shall consider the DG Set based on Cl No. 4.10.00 of SUB SECTION-II-E11, Part B. Employer to confirm.	Bidder requested to refer the amendment in this regard.
463.	VI/B	SUB SECTION-II-E11 DIESEL GENERATOR	3 of 17	4.10.00	The DG set shall be capable of starting largest size of emergency 415 V drive (motor) having starting KVA/rated KW ratio of 8 (higher if starting current is more than 8) and starting power factor of 0.2 with terminal voltage drop being restricted to 15%. Generator loading before		
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		ORS			starting of this motor shall be considered as 50% of generator rating.		
464.	VI/B	SUB SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	1 of 8	1.01.00	For equipment in air conditioned areas, design ambient temperature shall be 35 deg.C , if 2x100% air conditioning system is provided unless specified specifically in relevant sub sections.	Both clauses are contradictory to each other. Bidder shall consider 40 deg C design temp for VFD Panels located in air condition room, as per manufacturer design standard practice	Bidder understanding is not correct. Design ambient temperature is specified in Sub Section II E-19 as 50 deg C.
465.	VI/B	SUB-SECTION II-E-19 VFD	2 of 15	3.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg.Centigrade and also relative humidity of 95% at 40 deg. Celsius shall be considered.		

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466.	VI/B	SUB-SECTION II-E-19 VFD	7 of 15	12.08.00	Type: Outdoor Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.	Bidder wish to clarify that MV VFD with dry type integral rectifier/converter duty transformer shall be forced cooled dry type instead of natural air-cooled dry type	Bidder is requested to refer the amendment in this regard.
467.	VI/B	SUB-SECTION II-E-19 VFD	7 of 15	12.08.00	Temperature rise: Winding temperature rise shall be as per applicable IEC.	Bidder shall consider rectifier/converter duty Dry type transformer with class "H" insulation and temperature rise as per IEC (i.e. 115 deg C at 50deg Ambient). Employer to confirm.	Bidder to follow Sub-Section II E-19 for VFD Transformer requirements.
468.	VI/B	SUB SECTION-II-E12 TRANSFORMERS/ REACTOR	16 of 21	2.00.00	Maximum Temperature rise of winding over 50 deg. C ambient shall be 70 deg.C.		
469.	VI/B	SUB-SECTION	7 of 15	11.04.00	The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation	Bidder wish to clarify that this clause is not applicable for LT VFD. Bidder also wish to clarify that fan	Bidder clarification noted in respect of LV VFD when not envisaged with
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		II-E-19 VFD			of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.	failure detection will be achieved by temp. detectors only for MV VFD.	cooling air fan. Bidder to comply specification requirements in respect of MV VFD.
470.	VI/B	SUB-SECTION II-E-19 VFD	11 of 15	23.01.00	The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following: i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection. ii) Incoming and outgoing line surge protection. iii) Under / over voltage protection iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection. v) Instantaneous Over current & Earth fault protection vi) Converter/Inverter module failure indication. vii) Over frequency/speed protection. viii) Ventilation failure indication & alarm. ix) Over temperature of VFD	Bidder wish to clarify that point no. I, II, Viii, X, Xi & Xii are not applicable for LT VFD. Employer to confirm.	Protections applicable shall be decide during detail engineering based on the LV VFD scheme.
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					x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.		

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471.	VI/B	SUB-SECTION II-E-19 VFD	12 of 15	24.01.00	Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door. i) Start / stop (in local/remote mode) ii) Speed control (Raise / lower) iii) Acknowledge/Accept/ Test Push Button for annunciation iv) Auto / Manual / Test Mode select v) Emergency stop vi) Trip-Remote Breaker	Bidder wish to clarify that point no. III, IV & VI are not applicable for LT VFD. Employer to confirm.	Control function applicable shall be decide during detail engineering based on the LV VFD scheme.
472.	VI/B	SUB SECTION II-E-10 LT SWITCHGEAR S & LT BUS DUCTS	9 of 57	4.08.00	The enclosure for outdoor panels shall be constructed of stainless steel sheets in order to have protection against corrosion. The Degree of protection for outdoor panels shall be IP: 55.	Bidder shall consider suitable mild steel / cold-rolled sheet steel instead of stainless steel sheets with IP 65.	Technical Specifications to be complied with.

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473.	VI/A	SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT	10 of 13	1.17.00/2(Singrauli STPP Stage-I and II)	Bidder shall create new 33kV FGD tie switchgear in switchyard area which shall be used for feeding of bidders FGD loads as indicated in relevant tender SLD. Two nos. 33kV feeders shall be provided from this switchgear for feeding of 33/11.5kV miscellaneous service transformer of ratings as indicated in relevant tender SLD (HT Trf#5 &6). These transformers shall be in scope of bidder and shall be used for feeding of employers existing 11kV colony switchgear.	During Site visit Bidder found that no sufficient space is available for 33 kv switchgear room in switchyard area. After discussion with NTPC representative in site there is a probability to extent the colony switchgear room and accommodate 33 kv FGD switchgear in that room. Please confirm. Employer is requested to show the space for 33 kv FGD SWGR room in the GLP.	Space for 33kV FGD swgr room is indicated in GLP in switchyard area.
474.	VI Part A	SUB-SECTION-IV	2 of 3	1.08.00	Terminal Waste Water Points	Based on the feedback received during Rihand site visit, bidder proposed to use Sump of AWRPH of Stage-I as terminal point for waste water. Bidder requests employer to kindly confirm the same.	Specification requirement is clear. Bidder is requested to refer the specification in this regard.

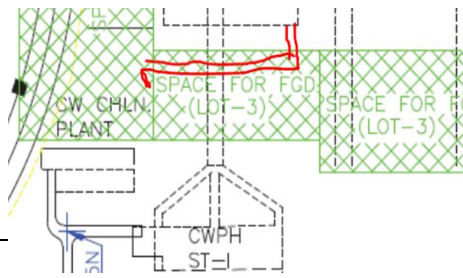
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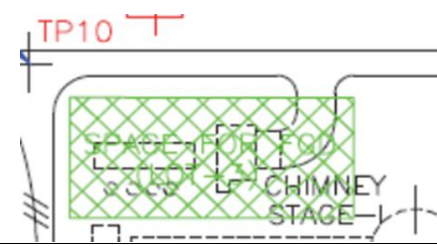
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475.	Rihand Site visit Feedback				GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP	During site visit 3 pipes were seen in space provided for FGD area between AWRP and CWPH Stage-I. These pipe are running along the road in FGD area because of which approx. 6.5 m wide area along the length in unusable. Snapshot of drg is attached for ready reference. Bidder understands that employer will reroute all these pipes and will provide clear space for FGD as per GLP. Bidder requests employer to kindly confirm the bidder understanding 	Earmarked area has been allocated for FGD facilities. These identified pipes shall be re-routed, if required during detail engineering.
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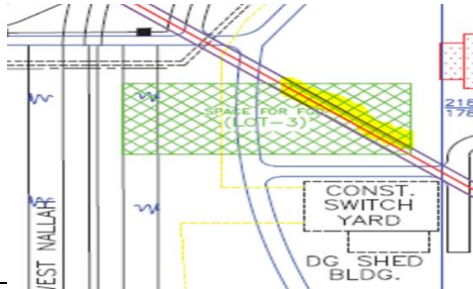
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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476.	Rihand Site visit Feedback				GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP	During site visit, Bidder found lot of underground cables and underground fire fighting pipes in Space provided for FGD behind U#1 . Bidder understands that employer will reroute these cables & pipes and will provide clear levelled space as per GLP for FGD. Bidder requests employer to kindly confirm the bidder understanding 	Bidder to note that existing MCC room and cable trestle shall be retained in the mentioned area. Bidder to refer revised Tender GLP.
477.	Rihand Site visit Feedback				GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP	Aux Boilers are available in the space provided for FGD behind U#1, Bidder understands that the same shall be dismantled by Employer & clear space shall be provided as marked in tender GLP. Bidder shall install the FGD facilities in this area, by reusing the	Bidder to note that existing MCC room and cable trestle shall be retained in the mentioned area. Bidder to refer revised
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						existing foundation to the extent possible. Hence bidder request employer to share the type & details of foundation for these aux. boilers.	Tender GLP. Existing Foundation drawings are not available. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES for detail scope dismantling.

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478.	Rihand Site visit Feedback				GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP	Bidder understands that at present no piping of IDCT is going through the space provided near construction switchyard as shown in GLP and complete space shown is available for FGD. Bidder requests employer to kindly confirm the bidders understanding. 	Proposed IDCT pipe routing shall be revised. Block area has been allocated for FGD facilities.
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479.	GLP GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP					Bidder is not able to find the FGL for two area provided near the CWPB stage-I and FGL of space marked outside plant boundary near to STP plant. At present these areas are heap of plant waste disposal material. Bidder requests employer to kindly confirm the FGL for these areas. Further, bidder understands that Employer shall provide levelled land as per this FGL (to be provided by Employer). 	Allocated area for FGD plant, after clearing plant waste, shall be available for bidder. However, filling in this area shall, if required from existing ground level after clearing plant waste, to proposed FGL is in Bidder scope.
480.	GLP GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP					Bidder requests employer to provide the drgs for ID fan outlet to existing chimney, for both the units.	Required drawings have been provided in the tender. However, detail drawing will be provided
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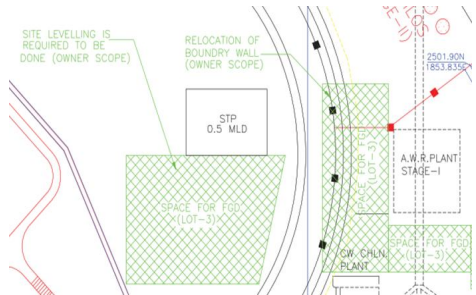
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							to bidder in case of award based on availability.
481.	GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP					Bidder understands that as mentioned in GLP Space for FGD (Lot-3) is a typo error and this space is applicable for Lot-4 tender.	Bidder understanding is correct. Bidder is requested to refer the GLP note in this regard.

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482.	GLP 1240-999-POC-F-001 Rev-08 for RIHAND STPP					Bidder understands that the plant Boundary shall be dismantled & re-routed by Employer before bidder starts the FGD site activities (1 months from NTP). Further, bidder understands that levelling of all the areas provided for FGD, shall be done by Employer before bidder starts the FGD site activities (1 months from NTP). 	Construction of new boundary wall and culvert over nallah and then dismantling of existing boundary wall will be in Bidder's scope. Refer Amendment in this regard.
483.	SECTION – VI, PART -A	III -A1 FGD	2 of 12	2.03.00	Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper is included	Bidder wish to clarify that bypass damper support & the FGD inlet duct support (at tapping points) will come on the raft of the existing Stack. Bidder request employer to confirm on	Bidder is requested to comply the specification requirement.
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					in the scope of the Contractor.	bidder's understanding.	
484.	SECTION – VI, PART -B	SUB-SECTION-IV-D Civil Works	4.01.00	18 of 70	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.	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 existing drain invert level.	Detail Will be provided after award of contract if available.
485.	SECTION – VI, PART -B	SUB-SECTION-IV-D Civil Works	4.01.00	18 of 70	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 (if any) 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.	Construction of new boundary wall and culvert over nallah and then dismantling of existing boundary wall will be in Bidder's scope. Bidder to comply the specification requirement
486.	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 .	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on
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							availability.
487.					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 clause No. 39.05.00, Part - B, sub-section IVD, Civil Works, Section VI.
488.					Topographical Survey drawing	Bidder request topographical survey drawing in AutoCAD format of all proposed FGD site.	Only PDF drawing is envisaged in tender
489.	SECTION – VI, PART -B	SUB-SECTION-IV-D Civil Works	38 of 70	22.00.00	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 shall provide all necessary documentation for seeking approval from appropriate authority(if necessary) by the Owner.	Bidder is requested to comply the specification.

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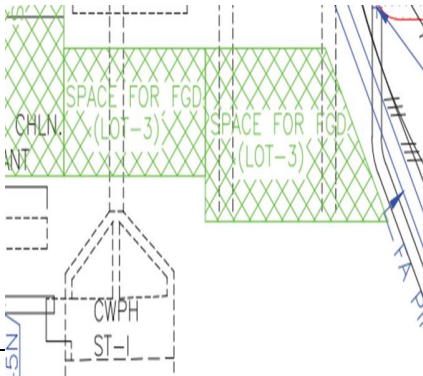
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490.	SECTION – VI, PART -A	SUB-SECTION- III-D Civil Works	1.03.00	1 of 3	The works covered under the scope of the bidder have to be executed in an operating / under construction power station. The bidder shall take all necessary precautions to protect 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 whatsoever, 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.	Bidder request Owner to please share drawings of Underground amenities planned around FGD areas so that Bidder can take care of it when planning for FGD amenities.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
491.	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 is requested to comply the specification requirement.
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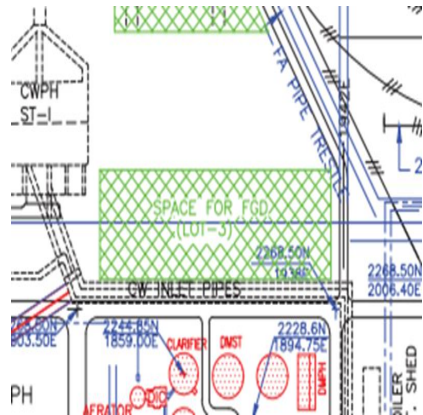
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492.	General				Chemical parameters of Ground Water	Bidder request Owner to please furnish the Chemical properties of Ground Water found in the Soil Report.	Bidder is requested to refer the amendment in this regard.
493.	General				Borelog data for Rihand II & III(4X500 MW)	Bidder request Owner to please furnish the Borelog Data in the Soil Report enabling bidder to estimate the civil foundation quantity for FGD equipments.	Bidder is requested to refer the clause No. 7.02.00. of Civil chapter.
494.	General				Foundation recommendation for Rihand	Bidder request Owner to please furnish foundation recommendation(Net allowable bearing capacity) in soil stratum based on depth below NGL/FGL.	Contractor is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pres- sure shall be adopted after approval of geotechnical investigation report.
495.	General				Foundation recommendation for Singrauli	Bidder request Owner to please furnish foundation recommendation(Net allowable bearing capacity) in soil stratum based on depth below NGL/FGL.	Contractor is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pres- sure shall be adopted
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							after approval of geotechnical investigation report.
496.	SECTION – VI, PART -A	SUB-SECTION-II-A5 Project Information (Rihand)	7.02.01	9 of 32	c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. Tender GLP (1240-999-POC-F-001): 	During site visit, NTPC site representative informed that the area (as per snapshot) allocated for FGD is a compacted fill area, however as per tender specification no foundations shall be kept on filled up soil. So bidder understand that as this space is allotted for FGD, so bidder shall use this area for installation of any FGD equipments/ facilities without any restriction. Further, Bidder requests Employer to share the foundation recommendation (Net allowable bearing capacity) in compacted soil fill based on depth below NGL/FGL for this areas enabling bidder to estimate the equipment foundations in this area, in bidding stage.	Bidder to comply technical specifications. Further Bidder is requested to refer the clause No. 7.02.00. of Civil chapter.
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497.	SECTION – VI, PART -A	SUB-SECTION-II-A5 Project Information (Rihand) Tender GLP (1240-999-POC-F-001):	32 of 33		Tender GLP (1240-999-POC-F-001): 	As per site visit, bidder understands that approximately 50m wide space is allocated for FGD facilities from CW inlet pipe (near road) along N-S direction. NTPC site representative informed that area adjacent to FGD allocated space is filled/ dumped with plant scrap for approx. 30 m depth. Employer to clarify the following in this regard: 1. At present, bidder has considered 50 m wide space (N-S direction) available for FGD facilities. If this consideration is not correct, then Employer to confirm the exact dimensions of this area in bidding stage only. As limited space is available for FGD facilities, this input/ confirmation is very crucial in bidding stage. 2. Employer to confirm that, the area adjacent to FGD allocated space is properly filled, so that bidder can	Bidder to plan their facilities within the space earmarked in GLP for FGD Lot-4 pkg. Exact width of area available in the mentioned block to be ascertained by the bidder based on their site visit. Bidder to ascertain the level of compaction based on their
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						install any FGD facilities in this area without apprehension of slope failure because of load envelope below the foundations of FGD facilities.	geotechnical investigation. Suitable measures of slope protection, if required, to be taken during construction in the area.
498.	SECTION – VI, PART -A	SUB-SECTION- III	1.11.00	5 of 6	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.	Both the clauses are contradictory to each other. Bidder understand following : Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions	Bidder is requested to comply the specification requirement

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499.	SECTION – VI, PART -A	SUB-SECTION- III	1.11.00	6 of 6	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	like sheds, trees, buildings, pipes, any equipment's etc. and will be in owner's scope. However, site clearance like removal of only bushes & vegetation etc. is in bidder's scope. Further Tree cutting may also be required in the laydown/Storage/preassembly/ fabrication area/duct & pipe/cable trestle routing etc., So Bidder understand that same shall be in employer scope along with FGD area Employer to confirm on bidders understanding.	Bidder is requested to comply the specification requirement
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					the Employer. All such changes will be as per drawings and work plan approved by the employer		

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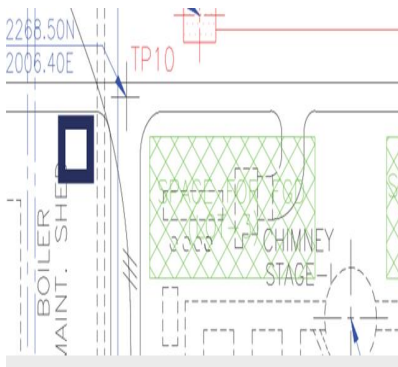
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
500.	SECTION – VI, PART -A	SUB-SECTION-I	2.5	13 of 19	Design agency for Civil & Steel Structural Works: 2.5 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	Regarding Chimney design agency, Bidder would like to inform that there is no difference in shell/ foundation design of stack with different material of flues, hence Bidder request Employer to delete mention of flue material from sub PQR for chimney. Bidder requests employer to amend the QR criteria for Chimney design agency as mentioned below; (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.	Bidder is requested to comply the specification requirement
501.	SECTION – VI, PART	SUB-SECTION-III-7	2.02.00	2 of 5	Valves with high lift cage guided plugs & quick-change trims shall be supplied	Cage guided valves are mainly used in high pressure application. Since our valve operating pressures and pressure drops are very low, top	Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 247 of 364

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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	-B					guided valves can be used. So Bidder request employer to allow top guided valves.	
502.	SECTION – VI, PART -B	SUB-SECTION-I-M1	8.09.00	31 of 51	The design of the shaft shall ensure that the critical speed is at least 20 % above the operating speed of the shaft .	Bidder understand following: The design of the shaft shall ensure that the operating speed is at least 20% below the critical speed of the pump .	Bidder is requested to comply the specification requirement
503.	SECTION – VI, PART -A	SUB-SECTION-VII Mandatory Spare	1.17.00	11 of 63	<u>Horizontal Centrifugal Pumps (All water pumps):</u> 5. Pump discharge Isolation valve assembly : 1 no. each type, size, rating	Only 1 no. isolation valve at pump discharge is considered. No NRV at pump outlet is considered as spare.	Bidder is requested to comply the specification requirement
504.	SECTION – VI, PART -A	SUB-SECTION-VII Mandatory Spare	1.16.00	10 of 63	<u>Sump Pumps:</u> 5. Pump discharge valve assembly : 1 no. of each type	This clause is not applicable, since separately, 4 nos. of slurry valve of each type & size already mentioned as mandatory spare for slurry line valve in cl. No. 1.11.00 (Section-VI, Part-A, Sub-section VII, Mandatory Spare, Pg. 10 of 63).	Bidder is requested to comply the specification requirement
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 248 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
505.	SECTION – VI, PART -A	SUB-SECTION-II-A5Project Information (Rihand)Tender GLP (1240-999-POC-F-001):	32 of 33		Tender GLP (1240-999-POC-F-001): 	During site visit, bidder found that there is a water sump available near TP 10 (refer snapshot), which is not shown in tender GLP. Bidder understand that same can be installed by Employer so that duct & pipe /cable trestle foundations can be put in this area. Employer to confirm bidder's understanding.Further, Employer is requested to update the tender GLP.	Bidder to plan their pipe/cable trestle avoiding interference with existing owner's facilities.

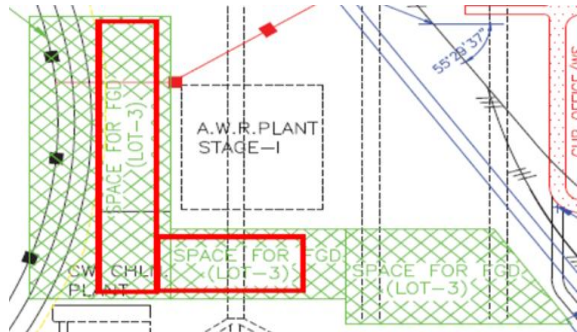
**LOT-4 PROJECTS
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
506.	Rihand Site Visit Feedback				Tender GLP (1240-999-POC-F-001): 	Bidder can't enter in some areas (Highlighted by Red rectangle in the screenshot) provided as space for FGD due to large trees, bushes in available area, So bidder can't see any existing facility , pipe, cables etc. in this area. If these exists employer will reroute them and provide clear space during execution.	Earmarked block area has been allocated for FGD facilities. Facilities shall be re-routed/dismantled, if required during detail engineering. Further, Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard for details scope.

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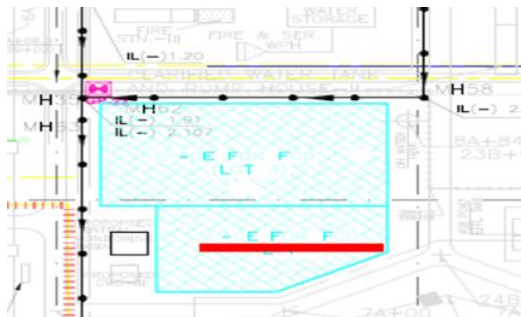
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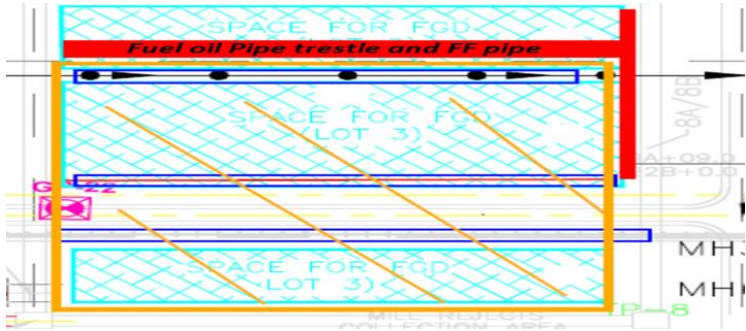
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY																																																																																																																																						
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507.	Rihand Site Visit Feedback	Tender GLP (1240-999-POC-F-001): 				Bidder requests to provide the detail of buried CW inlet pipe lines i.e. dia of pipe, depth of buried pipe so that bidder can properly estimate the crane path for entry in provided area and if any strengthening is required for crane entry same can be estimated in tender.	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.																																																																																																																																						
508.	General				<table><tr><th colspan="9">LOT - 4 CHIMNEY DETAILS</th></tr><tr><th colspan="9">EXISTING</th></tr><tr><th>Sl. No.</th><th>Project</th><th>Stage</th><th>UNIT</th><th>Type of Chimney (single/multi at ground level)</th><th>Chimney shell outer diameter (mm)</th><th>Chimney foundation outer diameter (mm)</th><th>Type of foundation</th><th>Level of Top of foundation (m)</th><th>Level of Bottom of foundation (m)</th></tr><tr><td rowspan="3">1</td><td rowspan="3">FGD/TPP</td><td>I</td><td>2X210</td><td>Twin</td><td colspan="5">Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.</td></tr><tr><td>II</td><td>2X210</td><td>Twin</td><td colspan="5"></td></tr><tr><td>III</td><td>1X210</td><td>Single</td><td>25.00</td><td>36.22</td><td>Pile</td><td>RL (+) 106.00</td><td>RL (+) 103.00</td></tr><tr><td rowspan="3">2</td><td rowspan="3">Parakia</td><td>I</td><td>3X200</td><td>Multi</td><td colspan="5">Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.</td></tr><tr><td>II</td><td>2X500</td><td>Twin</td><td colspan="5"></td></tr><tr><td>III</td><td>1X500</td><td>Single</td><td>32.00</td><td>44.1</td><td>Pile</td><td>RL (+) 25.5</td><td>RL (+) 22.75</td></tr><tr><td rowspan="2">3</td><td rowspan="2">Khaligson</td><td>I</td><td>4X210</td><td>Multi</td><td colspan="5"></td></tr><tr><td>II</td><td>3 X 500</td><td>Single</td><td colspan="5"></td></tr><tr><td rowspan="3">4</td><td rowspan="3">Singrauli</td><td>I</td><td>5 X 200</td><td>Twin</td><td colspan="5">Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.</td></tr><tr><td>II</td><td>2X500</td><td>Twin</td><td colspan="5"></td></tr><tr><td>III</td><td>2X500</td><td>Twin</td><td colspan="5"></td></tr><tr><td>5</td><td>Rihand</td><td>I</td><td>2X500</td><td>Twin</td><td colspan="5"></td></tr></table>	LOT - 4 CHIMNEY DETAILS									EXISTING									Sl. No.	Project	Stage	UNIT	Type of Chimney (single/multi at ground level)	Chimney shell outer diameter (mm)	Chimney foundation outer diameter (mm)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)	1	FGD/TPP	I	2X210	Twin	Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.					II	2X210	Twin						III	1X210	Single	25.00	36.22	Pile	RL (+) 106.00	RL (+) 103.00	2	Parakia	I	3X200	Multi	Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.					II	2X500	Twin						III	1X500	Single	32.00	44.1	Pile	RL (+) 25.5	RL (+) 22.75	3	Khaligson	I	4X210	Multi						II	3 X 500	Single						4	Singrauli	I	5 X 200	Twin	Foundation Data is not available. Bidder may conduct Ground Penetration Radar (GPR) Test to know the extent of existing chimney foundations.					II	2X500	Twin						III	2X500	Twin						5	Rihand	I	2X500	Twin						Bidder requests employer to kindly provide the foundation detail of existing chimneys. It is difficult to conduct the GPR test at this stage, considering the short duration of bidding.	Details of existing foundations are not available.
LOT - 4 CHIMNEY DETAILS																																																																																																																																													
EXISTING																																																																																																																																													
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

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509.	PE-DG-401-100-M001 Rev 11 (Unchahar)					Bidder requests employer to provide the drgs for ID fan outlet to chimney area for Stage-I, II & III	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
510.	PE-DG-401-100-M001 Rev 11 (Unchahar) Site Visit Feedback					During site visit Bidder find 4 pipes are going through the space provided for FGD (Screenshot of that provided area is shown) as visible from road. Bidder understands that NTPC will reroute these pipes and provide us the clear space free from these pipes and any other underground/over ground pipes, cable etc. as bidder was not able to enter in this area due to large trees, bushes in this area.	Refer note 2 of Tender GLP. Existing pipe/ cable trestle and existing pipes are to be retained. Bidder to plan FGD facilities accordingly.
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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511.	PE-DG-401-100-M001 Rev 11 (Unchahar) Site Visit Feedback					During site visit bidder observed that fuel oil pipe trestle is going through the provided area and also few fire hydrant pipes are going over the ground in provided area. Fuel oil pipe trestle & fire hydrant present location is shown by red color parallel to railway track in screens shot. Bidder understand that employer will reroute all these pipes & trestle and will provide clear space without any hindrances.	Refer note 2 of Tender GLP. Existing pipe/ cable trestle and existing pipes are to be retained. Bidder to plan FGD facilities accordingly.
512.	PE-DG-401-100-M001 Rev 11 (Unchahar) Site Visit Feedback					Bidder requests employer to kindly provide one block for setting FGD facilities as shown by yellow color rectangle after rerouting the sewer line, pipe line and road coming in the rectangular block area after fuel oil pipe trestle. All pipelines which required rerouting are highlighted with blue color.	Bidder to accommodate FGD system facilities in spaces marked for FGD in tender GLP drg.

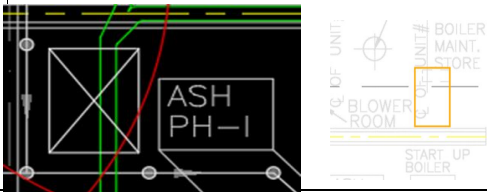
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513.	PE-DG-401-100-M001 Rev 11 (Unchahar) Site Visit Feedback				General Point	Bidder requests employer to kindly provide extra space for use of FGD as highlighted with yellow color adjacent to Stage-I chimney. (After dismantling of BM shed, and open store yard near Unit#1) & another space adjacent to ash slurry PH stage I (refer below snapshots). 	Bidder to accommodate FGD system facilities in spaces marked for FGD in tender GLP drawing.

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
514.	SECTION – VI, PART -A	SUB-SECTION- III-A4	1.01.01 & 1.01.02	1 of 10 & 2 of 10	EQUIPMENT COOLING WATER SYSTEM 1.01.01 ECW for FGUTPP ST-I (2X210MW) FGD SYSTEM 1.01.02 ECW for FGUTPP ST-II (2X210MW) & ST- III (1 X210 MW) FGD SYSTEM	As per tender specification, Employer is providing 2 sources of water-one from clarified water tank & other from CWBD of stage II&III. Bidder would like to use CWBD water for ECW system & clarified water will be sent directly to Process water tank. Bidder recommend to install one (1) ECW system common for both FGD units (all stages) instead of separate ECW system, mentioned in the tender specifications. Further, bidder would like to inform that there are only 2 absorbers (for 5 boiler units) & common Limestone grinding, handling , Gypsum dewatering & handling system. SO there will be issues for balancing of water from ECW system considering common auxiliaries. Employer to confirm bidder's consideration for providing common ECW system for Unchahar project.	Bidder is requested to refer the amendment in this regard.

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
515.	SECTION – VI, PART -A	SUB-SECTION- III-A4	1.01.01 & 1.01.02	1 of 10 & 2 of 10	<u>1.01.01 ECW for FGUTPP ST-I (2X210MW) FGD SYSTEM</u> d) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps f) 3 x50% (2 working + 1 standby) capacity of plate type heat exchangers. g)3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. <u>1.01.02 ECW for FGUTPP ST-II (2X210MW) & ST- III (1 X210 MW) FGD SYSTEM</u> (e) 4 x 33.3% (3 working + 1 standby) capacity of plate type heat exchangers. (f) 5 x 33.3% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives for pumping of water from Cold secondary water header to discharging into the FGD system as process water. (g) 4 x 33.3% (3 Working + 1	Bidder understands that the "Total number of Units" mentioned in the P&ID refers to Number of FGD units (number of Absorbers) & not the number of Boiler units. In Unchahar, there are total 2 absorbers for 5 Boiler units. Accordingly, bidder shall consider the number of "Primary, secondary cooling water pumps & PHEs". Employer to confirm on bidder's above understanding/ consideration.	Bidders understanding is not correct. Total number of Unit means Boiler unit.
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					standby) capacity FGD DM (Primary) cooling water pumps along with drives.		

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516.	VI/E	DRAWING : 0011-109(4)-POM-A-004, P&ID for ECW system for FGD system package			P&ID for ECW system for FGD svstem packade <u>FGD AUXILIARY (SECONDARY) COOLING WATER PUMPS</u> TOTAL NUMBER OF PUMPS = TOTAL NUMBER OF UNITS + 2 NUMBER (AS COMMON STAND BY) TOTAL NUMBER OF PHE = TOTAL NUMBER OF UNITS + 1 NUMBER (AS COMMON STAND BY) <u>FGD DM (PRIMARY) COOLING WATER PUMPS</u> TOTAL NUMBER OF PUMPS = TOTAL NUMBER OF UNITS + 1 NUMBER (AS COMMON STAND BY)		Bidder is requested to comply the specification requirement.

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
517.	SECTION – VI, PART -A	SUB-SECTION- III-A4	4.01.01	8 of 10 & 9 of 10	EQUIPMENT COOLING WATER SYSTEM 4.01.01 ECW for SINGRAULI STPP ST-I (5 X 200 MW) FGD SYSTEM 4.01.01 ECW for SINGRAULI STPP ST-II (2 X 500 MW) FGD SYSTEM	As per tender specification, Employer is providing only clarified water from 2 sources- one from stage-I & other from stage II. Considering same water quality from both the sources, Bidder recommend to install one (1) ECW system common for four FGD units (all stages) instead of separate ECW system, mentioned in the tender specifications. Further, bidder would like to inform that there are only 4 absorbers (for 7 boiler units) & common Limestone grinding, handling , Gypsum dewatering & handling system. So there will be issues for balancing of water from ECW system considering common auxiliaries. Employer to confirm on bidder's consideration for providing common ECW system for Singrauli project.	Bidder is requested to refer the amendment in this regard.

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
518.	SECTION – VI, PART -A	SUB-SECTION- III-A4	4.01.01	8 of 10 & 9 of 10	<u>4.01.01 ECW for SINGRAULI STPP ST-I (5 X 200 MW) FGD SYSTEM</u> d) 7 x 20% (5 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps f) 6 x 20% (5 working + 1 standby) capacity of plate type heat exchangers. g) 6 x 20% (5 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. <u>4.01.01 ECW for SINGRAULI STPP ST-II (2 X 500 MW) FGD SYSTEM</u> (d) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives for pumping of water from Cold secondary water header to discharging into the FGD system as process water. (f) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. (g) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.	Bidder understands that the "Total number of Units" mentioned in the P&ID refers to Number of FGD units (number of Absorbers) & not the number of Boiler units. In Singrauli, there are total 4 absorbers for 7 Boiler units. Accordingly, bidder shall consider number of "Primary, secondary cooling water pumps & PHEs". Employer to confirm on bidder's above understanding/ consideration.	Bidders understanding is not correct. Total number of Unit means Boiler unit.

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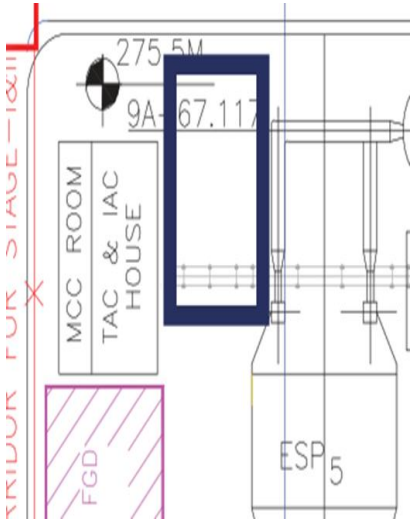
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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519.	VI/E	DRAWING : 0011-109(4)-POM-A-004, P&ID for ECW system for FGD system package			P&ID for ECW system for FGD system package <u>FGD AUXILIARY (SECONDARY) COOLING WATER PUMPS</u> TOTAL NUMBER OF PUMPS = TOTAL NUMBER OF UNITS + 2 NUMBER (AS COMMON STAND BY) TOTAL NUMBER OF PHE = TOTAL NUMBER OF UNITS + 1 NUMBER (AS COMMON STAND BY) <u>FGD DM (PRIMARY) COOLING WATER PUMPS</u> TOTAL NUMBER OF PUMPS = TOTAL NUMBER OF UNITS + 1 NUMBER (AS COMMON STAND BY)		Bidder is requested to comply the specification requirement.
520.	SECTION – VI, PART -A	SUB-SECTION-III-A5	2.01.16	4 of 12	Minimum four (4) Nos. sump pumps in limestone storage shed / Silos	There is no requirement for separate sumps for bulk limestone silos, as Bulk silos are placed close to ball mill building already having sump. If still Employer insists for providing Sumps in Limestone bulk silo area, please clarify the following: In Unchahar & Rihand, there will be only 2 Bulk silos,. However, specifications asks for 4 number of	Bidder to follow the specification of technical specification. Bidder to provide 4 number of sump drainage pump in two number of sump drainage pit each having (1W+1SB) pumps at both end of silos.
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						sumps, which is not required.	
521.	SECTION – VI, PART -A	SUB-SECTION- III-A5	4.11.00	10 of 12	Belting and Pulleys for 1200 TPH	Bidder understands that this clause is applicable for Lot 4 projects.	Belting and pulley for 1200TPH is not applicable for LOT-4 projects.

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522.	IIA-4-PROJECT INFORMATION SINGRAULI	General layout plan	Drg. No. 1150-999-POC-F-001			Bidder requests employer to kindly provide extra space for use of FGD facilities as highlighted in blue color adjacent to MCC room, which is not in use. (refer snapshot).	Bidder to accommodate FGD system facilities in spaces marked for FGD in tender GLP drawing.

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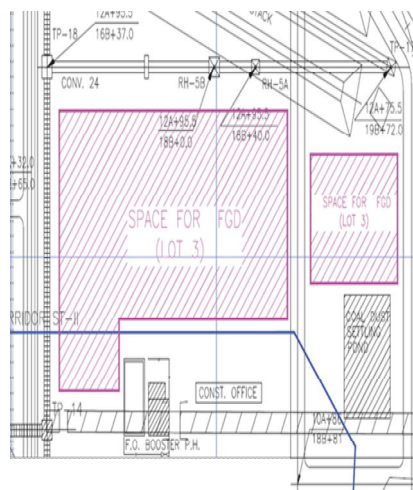
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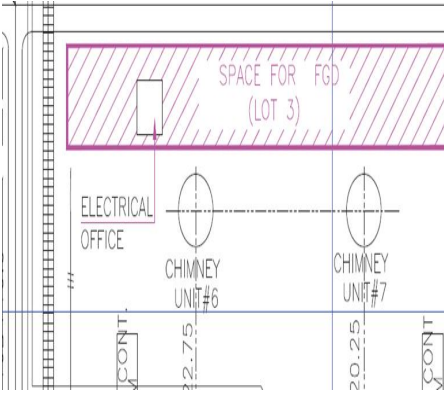
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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523.	IIA-4-PROJECT INFORMATION RAULI	General layout plan Drg. No. 1150-999-POC-F-001				Bidder request employer to provide updated GLP. And following Elevation view details for existing facility around FGD allocated space. Unit-1,2, 3,4,5,6 & 7 Ducting:- 1. ID fan to chimney ducting Elevation and plan view for all units. Pipe racks & Building:- 1. Pipe rack details around the chimney area (Unit 1,2,3,4,5,6&7) . 2.Pipe rack around Existing Aux. boiler area in front of Unit-1,2&3 3.Existing Buildings, Ash slurry piping (ST-II)and pipe rack details of back side of chimneys (Unit#6, #7) to FGD area 4. Under construction building Details (MCC ROOM) near to unit-5 ESP area 5. Piping details (Over Ground) near Hydro bin silo (Unit#5) 6. ESP Foundation details (Unit-5) Conveyor details- 1. TP5 > Conveyor> TP6 > TP14 2. TP17 & TP18 > Conveyor > TP14>TP15	Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
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524.	IIA-4-PROJECT INFORMATION RAULI	General layout plan Drg. No. 1150-999-POC-F-001					1. Bidder to plan their FGD facilities as per site condition in the allocated areas. 2. Bidder may utilize the space providing alternate approach for the existing CHP facilities. 3. Bidder to refer Tender GLP. Area of coal stock pile, coal Slurry Settling Pond are not allocated for FGD facilities.
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525.	IIA-4-PROJECT INFORMATION RAULI		General layout plan Drg. No. 1150-999-POC-F-002			During site visit, it was observed that Electrical office is located in FGD allocated area (refer snapshot). Bidder understands that Employer shall give clear space to Bidder.	Electrical office shown in the Tender GLP shall be retained. Bidder to plan FGD facilities avoiding interference with this building.

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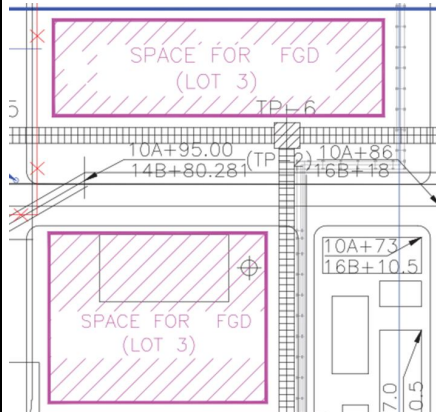
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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526.	IIA-4-PROJECT INFORMATION SINGRAULI	General layout plan Drg. No. 1150-999-POC-F-003				In absence of ID fan to Chimney inlet duct drawings, Bidder has considered the following dimensions of existing ducting based on visualization during site visit. <u>Singrauli:</u> Unit#1,3: Bottom of Duct: 12 m Duct Size (WxH) : 4m x 8m Unit#2: Bottom of Duct: 12 m Duct Size (WxH) : 4m x 8m Unit#4,5: Bottom of Duct: 12 m Duct Size (WxH) : 4m x 8m Unit#6,7: Bottom of Duct: 12 m Duct Size (WxH) : 5.65m x 5.65 m <u>Rihand:</u> 12.007 m(h) x 6m(w), bottom of duct 12m <u>Unchahar:</u> Unit 1 & 2: 13m (H) x 6.5 (w), bottom of duct 12m Unit 3 & 4: 13m (H) x 6.5 (w), bottom of duct 12m Unit 5 : 6.2m (H) x 5.1 (w), bottom of duct 9.5m	Issue of proposed dimension of the duct will be discussed during details engineering in case of award.
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						Employer to confirm on bidders considerations or furnish the requested drawings/ dimensions.	

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527.	IIA-4-PROJECT INFORMATION RAULI	General layout plan Drg. No. 1150-999-POC-F-003				During site visit, bidder found that the concrete sheds, Auxiliary boilers coal s etc. are coming in allocated space for FGD. Bidder understands that Employer shall give clear space to Bidder without any hindrances . 2. Further employer is requested to furnish the foundation details of Auxiliary Boiler, which will be dismantled by Employer.	1. Mentioned block areas have been allocated for FGD purpose. Auxiliary Boiler will be dismantled by the employer. 2. Drawings of existing foundation are not available. Dismantling of underground facilities is in Bidder's Scope.
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528.	IIA-4-PROJECT INFORMATION SINGRAULI		General layout plan Drg. No. 1150-999-POC-F-003			As per tender specification (Section-VI, Part-A, sub-section-III, cl. No. 1.11.00, pg 5 of 6), dismantling of all the facility in the space allotted for FGD shall be done by Employer. So bidder understand that Employer will dismantle the DG set, Hydro Bin silo & other facility shall be dismantled by Employer. Employer to confirm. If Bidders understanding is not correct, the Employer is requested to furnish clear dimension of the block which is available for FGD facilities.	As already mentioned in the Tender GLP, Bidder to plan their FGD facilities in the subject block area avoiding interference with existing facilities.
529.	SECTION – VI, PART -A	SUB-SECTION-III	1.11.00	5 of 6	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,		Bidder is requested to refer the clause 1.11.00 of PART-A SUB-SECTION-III SCOPE OF SUPPLY & SERVICES In this regard.
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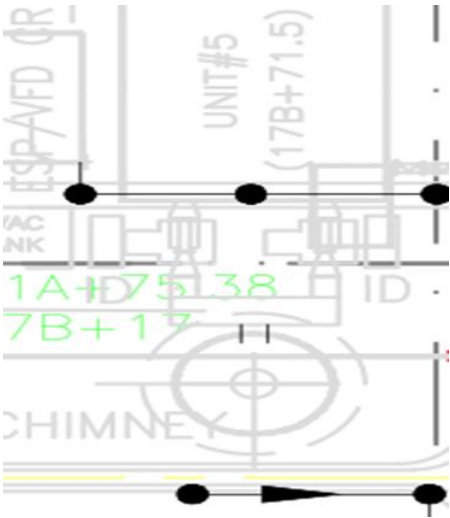
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					vegetation etc. is in bidder's scope.		
530.	General Point on GLP (General Layout Plan) for all LOT-4 Projects				Space for FGD LOT-4 Project	Bidder request Employer to confirm if any Sub-system(eg. LHS , GHS , Absorber , Stack etc.) of the FGD facilities has to be located in a specific area provided within space for FGD in plant GLP. Any such consideration may please be confirmed by Employer before submission of price bid as no preference/restriction regarding placement of FGD Sub-system is mentioned in tender GLP.	As already mentioned in the Tender GLP, Bidder to plan their FGD facilities in the subject block area avoiding interference with existing facilities.

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531.	General Point on GLP for all LOT-4 Projects					Near existing Chimney of Unit-5, during site visit it has been observed that there is a ramp along with wall provided to access into present FGD area from the nearby Main Road. However to facilitate crane movement for installation of duct for FGD purpose, that wall needs to be partially demolished and that ramp needs to be further modified. Bidder understands that such modification shall be facilitated by Owner. Owner is requested to clarify on Bidder's understanding.	NTPC understands that the subject query is pertaining to Unchahar project. Bidder may modify/strengthen the access and dismantle wall locally without interfering with owner facilities with site concurrence during erection stage.
532.	SECTION – VI, PART -A	SUB-SECTION-I-M1	5.05.00	16 of 51	<u>Emergency Spray System:</u> An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds	Bidder understands that this requirement of minimum time in case the gas temperature exceeds the design temperature shall be considered for design of automatic spray quenching water shall ensure	Bidder is requested to comply the specification requirement
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					the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures.....	that the temperature at the absorber inlet shall be brought down to the design temperature.	
533.	Sec-VI/Part-A	I	3 of 19	1.03.07	Low Height Wet Chimney(s) for the project (except Rourkela Project for which the Wet Chimney under construction is to be used)	Bidder presume that the Rourkela specified in this clause is a type error.	Bidder is requested to refer the Amendment in this regard.
534.	Sec-VI/Part-A	III-A4	1 of 10	1.01.00	The Bidder shall provide common Equipment Cooling water system (Primary & Secondary) for stage- II & III units whereas separate Equipment Cooling water system (Primary & Secondary) for stage- I units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system.	Owner is requested to clarify under which stage ECW system the cooling water requirements of common facilities (like Limestone, Gypsum) will be met out.	Bidder is requested to refer amendment in this regard.
535.	Sec-VI/Part-A	IIA3 Project Information	18 of 29	GLP 4230-999-POC-F-001/Rev.10	Space marked for FGD Lot-3	The distance between Existing Chimney and new wet stack will be in the range of 130-140 m for 2 FGD units in Stage-I of 4x210 MW due to space	Bidder is requested to comply the specification requirement.
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		n-Kahalgaon				constraint. Bidder requests NTPC to confirm.	
	Sec-VI/Part-B	IV-D	9 of 67	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.		
536.	Sec-VI/Part-B	I-M1	3 of 51	1.03.06	Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of SO ₂ emission of less than: (a) 200 mg/Nm ³ (6% O ₂ dry) for units having capacity of 500 MW <u>(b) 600 mg/Nm³ (6% O₂ dry) for units having capacity of 200 / 210 MW</u>	NTPC to confirm whether Outlet SO ₂ of 600 mg/Nm ³ is acceptable for the following FGD units a. Kahalgaon Stage-I-2 nos of 2x210 MW FGD units b. Farakka-Stage-I-3x200 MW FGD units c. Singrauli- Stage-I-3x200 MW and 2x200 MW FGD units d. FGUTPP-Stage-I,II & III-2 FGD units of 2x210MW and 3x210 MW	Bidder understanding is correct
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537.	Sec-VI/Part-B	I-M1	30 of 51	7.08.01	It should be possible to discharge each absorber into the Auxiliary Absorbent tank within 2 hours up to the suction line of the intended pump. Further, <u>Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.</u>	Absorber Drain pump proposed can discharge slurry of absorber recirculation tank from normal level upto pump trip level in 2 hours. However, from pump trip level to bottom of the tank, the slurry will be drained to absorber sump (by gravity) and time required for the same will be as per industry practice. We request Owner to accept the same.	Bidder is requested to comply the specification requirement
538.	Sec-VI/Part-B	I-M1	30 of 51	7.08.03	Agitation shall be provided to prevent settlement of slurry by top entry agitators with <u>emergency flush start system.</u>	Emergency flush start system are applicable for Side mounted agitator only, for top mounted agitator the same is not applicable.	Bidder is requested to comply the specification requirement
539.	Sec-VI/Part-B	I-M1	25 of 51	6.06.04	The slurry preparation tank shall be CS construction with replaceable <u>chlorobutyl/bromobutyl rubber lining of minimum 5 mm thickness.</u>	In line with clause no-10.01.00 rubber lining of 4mm thickness considered for Limestone Slurry preparation / storage tank.	Bidder is requested to refer the Amendment in this regard.

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	Sec-VI/Part-B	I-M1	32 of 51	10.01.00	Slurry tanks: Replaceable <u>Chlorobutyl/ Bromobutyl rubber lining of minimum 4 mm thickness</u>		
540.	Single Line diagram for all sites	-	-	0011-109(4)-POE-J-001/C Rev.B	FGD Service switchgear I & II for Stage I & FGD Service switchgear I & II for Stage II or Stage II & III	Please note that the following system as common for all stage & all absorber of each site. - Lime stone Handling system - Gypsum De watering system - Aux. cooling water system - Compressor - Fire fighting - AC & Ventilation Hence we have considered required number of FGD service transformer with 2x100% configuration for all above equipment as common for all stage of each site. Also for separate service transformer in each stage wise as indicated in tender SLD for above mentioned equipment are not possible and not considered.	Feeding arrangement for 11/6.6/3.3/0.415 kV shall be segregated stagewise as indicated in tender SLD of respective plant. However, feeding arrangement for common HT & LT loads shall be such that shut down of one stage shall not affect operation of FGD of other stage in the plant.
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541.	Single Line diagram for Kahalgaon Super Thermal Power Station	-	-	0011-109(4)-POE-J-001/C Rev.B	- One set of 3.3KV switchgear with 2 Nos. of 11/3.45KV transformer for Stage I HT motors - One set of 3.3KV switchgear with 2 Nos. of 11/3.45KV transformer for Stage II HT motors	We have considered the power supply feeders for common system HT motors (ie Lime stone, Gypsum, compressor, etc) shall be fed from any one of the nearest stage I 3.3KV switchgear or stage II 3.3KV switchgear. Kindly confirm.	Feeding arrangement for 11/6.6/3.3/0.415 kV shall be segregated stagewise as indicated in tender SLD of respective plant. However, feeding arrangement for common HT & LT loads shall be such that shut down of one stage shall not affect operation of FGD of other stage in the plant.
542.	Single Line diagram for FGU TPP	-	-	0011-109(4)-POE-J-001/C Rev.B	- One no. of 415V PMCC with 3x50% transformer for stage I absorber (One no. absorber for 2x210MW) - One no. of 415V PMCC with 3x50% transformer for stage II & III absorber (One no. absorber for 2x210MW + 1x210MW)	Please note that the total 415V LV loads for both absorbers are very low (Max. 1850KVA) and the switchgear for the same shall be located in common switchgear room as per site condition. Hence we have considered common one no. of 415V PMCC with 3x50% for both absorbers. Kindly confirm.	Feeding arrangement for 11/6.6/3.3/0.415 kV shall be segregated stagewise as indicated in tender SLD of respective plant. However, feeding arrangement for common HT & LT loads shall be such that shut down of one stage shall not affect operation of FGD of
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							other stage in the plant.
543.	Singl e Line diagr am for FGU TPP	-	-	0011-109(4)-POE-J-001/C Rev.B	Cable and cabling for connection upto Existing 33KV solar feeder is in Bidder scope.	Please provide the distance between new 33KV switchgear and existing solar 33KV feeders	Bidder may refer GLP to estimate distance between Bidder's new 33KV switchgear and existing solar 33KV feeder located in switchyard area . Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
						We have utilise the existing cable rack for new 33KV solar feeder incoming cable laying purpose. Kindly confirm.	Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities/trestle and availability of space/ trestle/ trench etc.
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							Existing cable rack shall be used as per space availability and acceptance by NTPC Site incharge.
544.	Single Line diagram for Singrauli STPS & Farakka Super Thermal Power Station	-	-	0011-109(4)-POE-J-001/C Rev.B	- One set of 6.6KV switchgear with 2 Nos. of 33/6.9KV transformer for Stage I HT motors - One set of 6.6KV switchgear with 2 Nos. of 33/6.9KV transformer for Stage II HT motors	We have considered the power supply feeders for common system HT motors (ie Lime stone, Gypsum, compressor, etc) shall be fed from any one of the nearest stage I 6.6KV switchgear or stage II 6.6KV switchgear. Kindly confirm.	Feeding arrangement for 11/6.6/3.3/0.415 kV shall be segregated stagewise as indicated in tender SLD of respective plant. However, feeding arrangement for common HT & LT loads shall be such that shut down of one stage shall not affect operation of FGD of other stage in the plant.

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545.	Single Line diagram for Singrauli STPS	-	-	0011-109(4)-POE-J-001/C Rev.B	Interconnection between owner use HT TRF 5 & 6 to Existing 11KV colony Switchgear	Kindly clarify the location of owner use transformer HT TRF 5 & 6.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
						We understand that the interconnecting cables from HT TRF 5 & 6 to existing colony switchgear is not in Bidder scope. Kindly confirm.	Interconnecting cables from HT TRF 5 & 6 to existing colony switchgear is in Bidder scope as indicated in Tender SLD.
						if the interconnecting cables is in bidder scope, please provide the location of the existing colony switchgear	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
546.	Single Line diagram for Kahalgaon			0011-109(4)-POE-J-001/C Rev.B	33KV cables and cabling for interconnection to Employers existing 33KV MUW line bay shall be in Bidder scope.	Please provide the distance between new 33KV switchgear and existing 33KV NUW line bay	Bidder may refer GLP to estimate distance between Bidder's new 33KV switchgear and existing 33KV MUW bays located in switchyard area. Bidder may also visit the project in order
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	STPP Stage -I and II						to get itself acquainted with existing electrical plant/facilities etc.
547.	Sec VI / Part A	Sub Section IIIB	11 of 13	1.17.00	Rihand STPP Stage-I Bidder shall re-equip 132kV Singrauli line bay at Rihand 132kV switchyard and use it to derive power for FGD system from through 132/34.5kV FGD Tie Transformer#2.	Requirement is not clear. Kindly elaborate.	Bidder shall replace existing equipment of 132kV Rihand-Singrauli bay with new equipment to derive power for FGD system through 132/34.5kV FGD Tie Transformer.
548.	Sec VI / Part A	Sub Section VI	24 of 25	5.00.00	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT 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.	Please note that the following transformers are considered for both FGD loads and owner loads. Hence we understand that the losses of following transformer are not envisaged for auxiliary power consumption calculation purpose of proposed FGD system. Kindly confirm Rihand STPP : Grid Transformer 132/34.5KV, 50MVA, 2 Nos. Employer new Transformer: 33KV/11.5KV, 12.5MVA, 1 no.	Bidder is requested to refer the amendment in this regard.
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						Kahalgaon STPP : Grid Transformer 132/34.5KV, 80MVA, 2 Nos. FGUTPP: Grid Transformer 220/34.5KV, 50MVA, 2 Nos. Singrauli STPS : Grid Transformer 132/34.5KV, 80MVA, 2 Nos. Employer new Transformer: 33KV/11.5KV, 12.5MVA, 2 nos.	
549.	Sec VII	Appendix - 4			Time Schedule	Request to reconsider the Time Schedule for Farakka, Kahalgaon, Rihand and Singrauli as follows: 1. Commissioning of FGD System : 27 Months 2. Completion of Facilities: 30 Months	Bidder is requested to comply the specification requirement
550.	SECTION-VI, PART -A	SUB-SECTION-V SALIENT DESIGN DATA	7 of 23	3.00.00 B	SALIENT DESIGN DATA: 8. SO ₂ removal Efficiency (Continuous) (%): 96	Bidder understands that for Kahalgaon St-I, 96% removal efficiency is to be achieved at the absorber outlet without considering the SO ₂ present in the by passed flue gas.	Bidder understanding is correct.
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551.	SECTION-VI, PART -A	SUB-SECTION-V SALIENT DESIGN DATA	1 of 23 3 of 23 5 of 23 7 of 23 9 of 23	2.00.00 A 2.00.00 B 3.00.00 A 3.00.00 B 3.00.00 C	Gas flow at the FGD inlet when firing respective coal (Nm3/sec)*	Please note that gas flow at the FGD inlet is mentioned in Nm3/sec and m3/sec in the mentioned clauses wherein discrepancy is found between the values. Bidder shall consider flue gas flow mention in Nm3/sec for FGD design and guarantee point. Please confirm.	NTPC Noted.
552.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	3 of 51	1.03.08	In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system of 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.	Agitators are not required to be connected to Emergency power supply as per proven practice being followed by QFGDM. Equipment needing emergency power connection shall be decided based on process requirement and the recommendations from the QFGDM & OEM for different equipment.	Bidder is requested to comply the specification requirement

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553.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	5 of 51	3.01.00	The entire flue gas system, flue gas ducts inlet to absorber and bypass duct etc. shall be designed to meet the following conditions: <table><tr><td>5.</td><td>Maximum flue gas velocity through the Absorber (M/sec)</td><td>Not more than 4 m/s at Design Point Conditions</td></tr><tr><td>6.</td><td>Recirculation Slurry pH</td><td>Not less than 6.5 under all operating conditions</td></tr></table>	5.	Maximum flue gas velocity through the Absorber (M/sec)	Not more than 4 m/s at Design Point Conditions	6.	Recirculation Slurry pH	Not less than 6.5 under all operating conditions	Point no. 5 & 6 of the attached Table is applicable only for conventional spray type absorber. In case of JBR technology Slurry pH will be maintained between 4 and 6 and velocities in side JBR (ex. inlet plenum, Sparger, Riser & outlet plenum) are different. Hence, the mentioned clauses are not applicable for our technology.	NTPC Noted
5.	Maximum flue gas velocity through the Absorber (M/sec)	Not more than 4 m/s at Design Point Conditions											
6.	Recirculation Slurry pH	Not less than 6.5 under all operating conditions											
554.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	15 of 51	3.01.00	For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher. Margin on Head : 10 % margin on the higher value of above.	In JBR technology, head requirement of oxidation blower is much less than 3500 mmWC as per on going executed NTPC projects. Hence, Bidder requests NTPC to change minimum head requirement to 3000 mmWg. Also, requirement of additional 10% margin on minimum head of 3000 mmWC is not required.	Bidder is requested to comply the specification requirement						
555.	SECTION –	SUB-SECTION	17 of 51	5.06.02	The scope of modelling shall include flue gas path inside the	Scope of modeling shall only be limited to inlet/outlet duct.	Bidder is requested to comply the specification						
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	VI, PART -B	ION-I-M1 (FGD)			absorber vessel including inlet and outlet duct.		requirement
556.	SECTION – VI, PART -B	SUB-SECTION- ION-I-M1 (FGD)	17 of 51	5.06.05	It shall be possible to reach the SO2 emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service.	Please note that this clause is not applicable for JBR technology.	NTPC Noted
557.	SECTION – VI, PART -B	SUB-SECTION- ION-I-M1 (FGD)	18 of 51	5.06.10	The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently.	Please note that no separate flushing nozzles are provided inside JBR. However, in JBR technology nozzles used in gas cooling section can meet this purpose.	NTPC Noted

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558.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	20 of 51	5.06.16	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), corrosion and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry). Optionally ceramic coating is also acceptable provided bidder/Collaborator has proven experience for the same. The slurry spraying system shall be made of material resistant to erosion and corrosion. During the lifetime of the plant, only the nozzles shall be replaced. The distribution system of the slurry shall be hydraulically optimized. The spray nozzles shall be of silicon carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The design of the spray nozzles shall be such that rapid wear, encrustation and plugging are avoided. Nozzle pipes and slurry spray nozzles shall	This complete clause is meant for spray type absorber and is not applicable for JBR. However, JBR specific modification given below. 1. Slurry spray headers are made of Nickel based alloy in gas cooling section as per proven design of QFGDM. 2. Air supply header inside JBR are made of FRP only. No anti-abrasive coating is required inside & outside of air supply header. 3. Only slurry spray nozzles in gas cooling section are made of SiC. Other slurry spray nozzles are made of SiC or High Alumina or equivalent having a minimum guaranteed life of 20,000 hrs. All wash and water nozzles and pipes are made of FRP/HTPVC/PP. SiC coating will be provided inside FRP slurry pipes.	Bidder is requested to comply the specification requirement
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					be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules.	4. Nozzle pipes and slurry spray nozzles shall be with bolted flanged or with socket connections.	

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559.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	21 of 51	5.06.20	It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles.	This complete clause is applicable for spray type absorber and not for JBR. In case of JBR technology, absorber is provided with Lower Deck and Upper Deck. It is possible to stand on the deck and carry out required maintenance. It is also possible to build platform at the bottom part of the JBR.	NTPC Noted
560.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	21 of 51	5.06.23	For the agitators a flushing system for start ups shall be provided.	Unlike side entry agitator of spray tower system, top entry agitator are used in JBR. As per QFGDM past experience, in JBR top entry agitator blades are located much above the gypsum settlement height during shutdown (gypsum settled at bottom). There is no possibility that agitator blades are covered with gypsum. Hence agitator can start without additional flushing. In all agitators (QFGDM supplied JBR systems) of JBRs supplied worldwide by QFGDM that are in successful operation, such flushing system is not provided.	Bidder is requested to comply the specification requirement
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						Hence, it is not applicable for JBR technology.	
561.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	14 of 51	5.01.00	B Bubbling Type Absorber However, 3 x 50% Gas Cooling Pumps instead of Slurry Recirculation shall be provided.	Bubbling Type Absorber However, 3 x 50% or 2 x 100% Gas Cooling Pumps instead of Slurry Recirculation shall be provided.	Bidder is requested to comply the specification requirement
562.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	21 of 51	5.06.23	In case Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The Screens shall be made of made of Alloy 59 /C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collaborator has proven experience).	In case Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The screen shall be made of Alloy 59/C276/ or abrasion resistant FRP/Polypropylene/SS316L/PVDF (In case Contractor/Collaborator has proven experience).	Bidder is requested to comply the specification requirement
563.	SECTION – VI,	SUB-SECTION-	21 of 51	5.06.24	It should be possible to discharge the absorber sump into the Auxiliary Absorbent tank within 2 hours.	Please note that time required to empty JBR shall be 8 to 15 hours.	Bidder is requested to comply the specification requirement
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	PART -B	I-M1 (FGD)					
564.	SECTION – VI, PART -E	Scheme of FGD - Absorber System Drg. No. 0011-109(4) - POM-A-001			Series of isolation valves at the downstream of Emergency water tank for Emergency quenching	Instead of series of isolation valves, there should be one quick acting isolation valve in the upstream of the Emergency quenching system.	Bidder is requested to comply the specification requirement
565.	SECTION – VI, PART -E	Scheme of FGD - Drg. No. 0011-109(4)			All valves and actuation type	Valves and their actuation type shall be decided by QFGDM as per process requirement.	Bidder is requested to comply the specification requirement
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		)- POM-A-001, 0011-109(4))- POM-A-002 & 0011-109(4))- POM-A-003					
566.	SECTION – VI, PART -B	SUB SECTION – I-M1 (FGD)	17 of 51	5.06.06	The mist eliminator wash piping/header shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same.	Carbon steel pipe shall be selected for outside pipe up to the nozzles at Mist Eliminator casing. Inside the mist eliminator casing piping header shall be of FRP/CSRL/PP/PVC as per tender specification.	Bidder is requested to comply the specification requirement

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567.	SECTION-VI, PART -A	SUB-SECTION-III-A4	3 of 10	2.01.01	ECW for KAHALGAON STPP ST-I (4X210MW) FGD SYSTEM (d) 6 x 25 % (4 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. With necessary pipe line and valves etc. for pumping of water from FGD clarified water tank to discharging into the FGD system as process water. (e) 6x100 % (4 Working + 2 standby) auto priming system for Auxiliary (Secondary) Cooling water pumps system.	Please note that as per clause (d), 6x25% Auxiliary (Secondary) Cooling water pumps are already provided. Please clarify the purpose of 6x100 % (4 Working + 2 standby) auto priming system for Auxiliary (Secondary) Cooling water pumps as mentioned in clause (e). Bidder has considered ACW pumps as per clause (d) mentioned above.	Bidder is requested to refer the amendment in this regard.
568.	SECTION-VI, PART -A	SUB-SECTION-III-A1 (FGD)	3 of 12	3.01.05	On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve.	Please note that as per QFGDM practice, valve in circulation line is not required.	Bidder is requested to comply the specification requirement
569.	SECTION-VI, PART	SUB-SECTION-III-A1	4 of 12	4.01.08	On/Off type Diaphragm valves in Gypsum circulation lines to be provided instead of pinch control valve.	Please note that as per QFGDM practice, valve in circulation line is not required.	Bidder is requested to comply the specification requirement
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	-A	(FGD)					
570.	SECTION-VI, PART -A	SUB-SECTION-III-A1 (FGD)	4 of 12	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 VFD drive may be provided based on process requirement.	Bidder is requested to comply the specification requirement.
571.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	1 of 10	1.01.01	ECW for FGUTPP ST-I (2X210MW) FGD (a) Cold secondary water shall be tapped from existing clarified water tank of FGUTPP ST-I and pumped to FGD clarified water tank through 3x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Discrepancy is found in the no. of clarified water pumps. As per P&ID, 2x100% pumps are shown whereas as per cl.1.01.01, 3x100% pumps are mentioned. Please clarify.	Bidder is requested to refer the amendment in this regard.
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	SECTION-VI, PART -E	0011-109(4)-POM-A-004 P&ID Diagram for ECW System for FGD Package			2x100% clarified water pumps		
572.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER	3 of 10	2.01.01	ECW for KAHALGAON STPP ST-I (4X210MW) FGD SYSTEM (a) Cold water shall be pumped from CW OAC of stage-I to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	1) Discrepancy is found in the no. of clarified water pumps. As per P&ID, 2x100% pumps are shown whereas as per cl.2.01.01, 3x100% pumps are mentioned. Please clarify. 2) Please clarify what does CW OAC means.	1.Bidder is requested to refer amendment in this
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		SYST EM					regard.
	SECT ION- VI, PART -E	0011- 109(4)- POM- A-004 P&ID Diagr am for ECW Syste m for FGD Pack age			2x100% clarified water pumps		2. CW OAC implies CW Open approach channel i.e CW channel

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573.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	5 of 10 6 of 10	3.01.01 3.01.02	ECW for FARAKKA STPP ST-I (3X200MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of FARAKKA STPP ST-I and pumped to FGD clarified water tank through 3x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. ECW for FARAKKA STPP ST-II (2X500MW) FGD SYSTEM (a) Cold water shall be tapped from existing service water tank of FARAKKA STPP ST-II and pumped to FGD clarified water tank through 3x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Discrepancy is found in the no. of clarified water pumps. As per P&ID, 2x100% pumps are shown whereas as per cl.3.01.01 and cl.3.01.02, 3x100% pumps are mentioned. Please clarify.	Bidder is requested to refer amendment in this regard.
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	SECTION- VI, PART -E	0011- 109(4))- POM- A-004 P&ID Diagram for ECW System for FGD Package			2x100% clarified water pumps		

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574.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	8 of 10 9 of 10	4.01.01 4.01.01	ECW for SINGRAULI STPP ST-I (5X200MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of Singrauli ST-I and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc. ECW for SINGRAULI STPP ST-II (2X500MW) FGD SYSTEM (a) Cold water shall be tapped from existing clarified water tank of SINGRAULI STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	Discrepancy is found in the no. of clarified water pumps. As per P&ID, 2x100% pumps are shown whereas as per cl.4.01.01, 3x100% pumps are mentioned. Please clarify.	Bidder is requested to refer amendment in this regard.
	SECTION-VI, PART	0011-109(4)-POM-			2x100% clarified water pumps		
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	-E	A-004 P&ID Diagram for ECW System for FGD Package					
575.	SECTION-VI, PART -A	SUB SECTION: III-A4 EQUIPMENT COOLING WATER SYSTEM	10 of 10	5.01.00	(a) Cold water shall be tapped from existing clarified water tank of RIHAND STPP ST-II and pumped to FGD clarified water tank through 3 x100% (1 working+2 standby) capacity pumps along with drives and necessary pipe line, valves etc.	1) Discrepancy is found in the no. of clarified water pumps. As per P&ID, 2x100% pumps are shown whereas as per cl.5.01.00, 3x100% pumps are mentioned. Please clarify.	Bidder is requested to refer amendment in this regard.

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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	SECTION-VI, PART-E	0011-109(4)-POM-A-004 P&ID Diagram for ECW System for FGD Package			2x100% clarified water pumps		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY																		
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.																					
576.	SECTION-VI, PART -B	SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM	15 OF 15	Annexure-II	Annexure-II Maximum Auxiliary (Secondary) water available:- <table><tr><th>Sl. No</th><th>Project</th><th>Maximum water available (cum/hr)</th></tr><tr><td>1</td><td>FGUTPP STAGE-I,II & III</td><td>265</td></tr><tr><td>2</td><td>KAHALGAON STPP STAGE-I & II</td><td>585</td></tr><tr><td>3</td><td>FARAKKA STPP A) ST-I (3X200MW) B) ST-II(2X500MW) C) ST-III(1X500)</td><td>A) 160 B) 265 C) 125</td></tr><tr><td>4</td><td>SINGRAULI STPP A) ST-I(5X200MW) B) ST-II (2 X500 MW)</td><td>A) 265 B) 265</td></tr><tr><td>5</td><td>RIHAND STPP-I (2 X500 MW)</td><td>265</td></tr></table>	Sl. No	Project	Maximum water available (cum/hr)	1	FGUTPP STAGE-I,II & III	265	2	KAHALGAON STPP STAGE-I & II	585	3	FARAKKA STPP A) ST-I (3X200MW) B) ST-II(2X500MW) C) ST-III(1X500)	A) 160 B) 265 C) 125	4	SINGRAULI STPP A) ST-I(5X200MW) B) ST-II (2 X500 MW)	A) 265 B) 265	5	RIHAND STPP-I (2 X500 MW)	265	Please note that Bidder understands the quantity mentioned in Annexure-II is the maximum amount of process water available for FGD. For gypsum washing, clarified water available is not included in Annexure-II.	Bidder is requested to refer the amendment in this regard.
	Sl. No	Project	Maximum water available (cum/hr)																						
1	FGUTPP STAGE-I,II & III	265																							
2	KAHALGAON STPP STAGE-I & II	585																							
3	FARAKKA STPP A) ST-I (3X200MW) B) ST-II(2X500MW) C) ST-III(1X500)	A) 160 B) 265 C) 125																							
4	SINGRAULI STPP A) ST-I(5X200MW) B) ST-II (2 X500 MW)	A) 265 B) 265																							
5	RIHAND STPP-I (2 X500 MW)	265																							
	SECTION-VI, PART -B	SUB-SECTION-IV TERMINAL POINTS & EXCLUSION	2 of 3	1.03.00	Note-(1) Gypsum Wash Water (Clarified Water) quantity available at TP will be 0.015m3/hr /MW.																				
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 301 of 364																		

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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		NS																	
577.	SECT ION- VI, PART -A	SUB- SECT ION- IV TER MINA L POIN TS & EXCL USIO NS	1 of 3	1.03.00	<table><tr><td>Sl No</td><td>Project / Stage</td><td>Process water</td><td>Gypsum Wash Water (Clarified Water)</td></tr><tr><td>1</td><td>FGUTPP- I (2 X 210 MW)</td><td colspan="2">Shall be tapped from clarified water tank of FGUTPP ST-I.</td></tr><tr><td>2</td><td>FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)</td><td>Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.</td><td>Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.</td></tr></table>	Sl No	Project / Stage	Process water	Gypsum Wash Water (Clarified Water)	1	FGUTPP- I (2 X 210 MW)	Shall be tapped from clarified water tank of FGUTPP ST-I.		2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)	Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.	1. Please furnish the terminal point parameters like flow, pressure, temperature, etc. 2. Please furnish the break up of maximum auxiliary (secondary) water available for stage-I and stage II & III. 3.Further, maximum process water requirement for FGD design case will be approx. 305 m3/hr. Hence, NTPC is requested to supply additional process water as per the process requirement furnished during detail engineering.	1.Bidder is requested to refer amendment in this regard. 2. Bidder is requested to refer amendment in this regard. 3. Bidder is requested to to comply technical specification.
	Sl No	Project / Stage	Process water	Gypsum Wash Water (Clarified Water)															
1	FGUTPP- I (2 X 210 MW)	Shall be tapped from clarified water tank of FGUTPP ST-I.																	
2	FGUTPP-II & III (2 X 210 MW, 1 X 210 MW)	Shall be tapped from CW Blowdown from the existing blow down header of stage- II & III available nearest to the FGD area.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of stage- II / III.																
	SECT ION- VI, PART -B	SUB SECT ION: I- M5 EQUI PME NT COO LING	15 OF 15	Annexure- II	Maximum Auxiliary (Secondary) water available:- 1. FGUTPP STAGE-I,II & III - 265 m3/hr														

**LOT-4 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY												
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.															
578.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1 of 3	1.03.00	<table><tr><td>3</td><td>Farakka-I (3 X 200 MW)</td><td colspan="2">Shall be tap off suitably from clarified water tank of Farakka STPP ST-I.</td></tr><tr><td>4</td><td>Farakka- II (2 X 500 MW)</td><td colspan="2">Shall be tap off suitably from from service water tank of Farakka STPP ST-II.</td></tr><tr><td>5</td><td>Farakka-III (1 X 500 MW)</td><td>Shall be tap off suitably from the existing blow down header available near FGD area of Farakka STPP ST-III.</td><td>Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.</td></tr></table>	3	Farakka-I (3 X 200 MW)	Shall be tap off suitably from clarified water tank of Farakka STPP ST-I.		4	Farakka- II (2 X 500 MW)	Shall be tap off suitably from from service water tank of Farakka STPP ST-II.		5	Farakka-III (1 X 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Farakka STPP ST-III.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.	1. Please furnish the terminal point parameters like flow, pressure, temperature, etc. 2.Further, maximum process water requirement for FGD design case will be approximately as under. A) ST-I (3X200MW) A)186 m3/hr B)ST-II(2X500MW) B)269 m3/hr C)ST-III(1X500) C)135 m3/hr Hence, NTPC is requested to supply additional process water as per the process requirement furnished during detail engineering.	1.Bidder is requested to refer the amendment in this regard. 2. Bidder is requested to refer the technical specification.
	3	Farakka-I (3 X 200 MW)	Shall be tap off suitably from clarified water tank of Farakka STPP ST-I.																
4	Farakka- II (2 X 500 MW)	Shall be tap off suitably from from service water tank of Farakka STPP ST-II.																	
5	Farakka-III (1 X 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Farakka STPP ST-III.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Farakka STPP ST-III.																
SECTION-VI, PART -B	SUB SECTION: I- M5 EQUIPMENT	15 OF 15	Annexure-II	Maximum Auxiliary (Secondary) water available:- FARAKKA STPP A) ST-I (3X200MW) A) 160 m3/hr B)ST-II(2X500MW) B) 265 m3/hr C)ST-III(1X500) C)125 m3/hr															
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 303 of 364												

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY								
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.											
		COOLING WATER SYSTEM													
579.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	<table><tr><td>6</td><td>Kahalgaon-I (4x 210 MW)</td><td>Water shall be pumped from suitable location of stage-I CW OAC.</td><td>Shall be tap off suitably from the existing AC cooling storage tank at stage-I.</td></tr><tr><td>7</td><td>Kahalgaon-II (3x 500 MW)</td><td>Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP ST-II.</td><td>Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Kahalgaon STPP ST-II.</td></tr></table>	6	Kahalgaon-I (4x 210 MW)	Water shall be pumped from suitable location of stage-I CW OAC.	Shall be tap off suitably from the existing AC cooling storage tank at stage-I.	7	Kahalgaon-II (3x 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP ST-II.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Kahalgaon STPP ST-II.	1. Please furnish the terminal point parameters like flow, pressure, temperature, etc. 2. Please furnish the break up of maximum auxiliary (secondary) water available for stage-I and stage II. 3.Further, maximum process water requirement for FGD design case will be approx. 620 m3/hr. Hence, NTPC is requested to supply additional process water as per the process requirement furnished during detail engineering.	1.Bidder is requested to refer amendment in this regard. 2. Bidder is requested to refer amendment in this regard. 3. Bidder is requested to to comply technical specification.
	6	Kahalgaon-I (4x 210 MW)	Water shall be pumped from suitable location of stage-I CW OAC.	Shall be tap off suitably from the existing AC cooling storage tank at stage-I.											
7	Kahalgaon-II (3x 500 MW)	Shall be tap off suitably from the existing blow down header available near FGD area of Kahalgaon STPP ST-II.	Shall be tap off suitably from the existing HVAC header (HVAC make up pump discharge) available near C-row of Kahalgaon STPP ST-II.												
	SECTION-VI, PART -B	SUB SECTION: I- M5 EQUIPMENT	15 OF 15	Annexure-II	Maximum Auxiliary (Secondary) water available:- 2.KAHALGAON STPP STAGE-I & II - 585 m3/hr										
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY						
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.									
		COOLING WATER SYSTEM											
580.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	<table border="1"><tr><td>8</td><td>Singrauli-I (5 x200 MW)</td><td>Tap off suitably from clarified water tank of Singrauli-I.</td></tr><tr><td>9</td><td>Singrauli-II (2 x500 MW)</td><td>Tap off suitably from clarified water tank of Singrauli-II.</td></tr></table>	8	Singrauli-I (5 x200 MW)	Tap off suitably from clarified water tank of Singrauli-I.	9	Singrauli-II (2 x500 MW)	Tap off suitably from clarified water tank of Singrauli-II.	1.Please note that maximum process water requirement for FGD design case will be approximately as under. A) ST-I(5X200MW) - 306 m3/hr Hence, NTPC is requested to supply additional process water as per the process requirement furnished during detail engineering.	Bidder is requested to comply the specification requirement.
	8	Singrauli-I (5 x200 MW)	Tap off suitably from clarified water tank of Singrauli-I.										
9	Singrauli-II (2 x500 MW)	Tap off suitably from clarified water tank of Singrauli-II.											
	SECTION-VI, PART -B	SUB SECTION: I- M5 EQUIPMENT	15 OF 15	Annexure-II	Maximum Auxiliary (Secondary) water available:- SINGRAULI STPP A) ST-I(5X200MW) - 265 m3/hr								
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 305 of 364						

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY			
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.						
		COOLING WATER SYSTEM								
581.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	<table border="1"><tr><td>10</td><td>Rihand-I (2 X 500 MW)</td><td>Tap off suitably from clarified water tank of Rihand-stage-II.</td></tr></table>	10	Rihand-I (2 X 500 MW)	Tap off suitably from clarified water tank of Rihand-stage-II.	Discrepancy is found in the source of clarified water. As per clause 1.03.00, clarified water is to be taken from stage-II clarified water tank whereas as per P&ID, it is shown as stage-I clarified water tank. Please clarify.	Bidder is requested to refer amendment in this regard.
	10	Rihand-I (2 X 500 MW)	Tap off suitably from clarified water tank of Rihand-stage-II.							
SECTION-VI, PART -E	0011-109(4)-POM-A-004 P&ID Diagr			2x100% clarified water pumps from Rihand St-I clarified water tank						
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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		am for ECW System for FGD Package					
582.	SECTION-VI, PART-A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	Note- (1) Gypsum Wash Water (Clarified Water) quantity available at TP will be 0.015m ³ /hr /MW.	Please note that as per our QFGDM practice, oxidation air quenching should be done with clarified water to prevent any scaling or buildup. Also, some amount of clarified water is required for slurry pump sealing purpose. Hence, additional clarified water is required for above mentioned systems apart from gypsum washing. Approximate amount of clarified water requirement required for gypsum washing, oxidation air quenching and slurry pump sealing is mentioned below. 1 FGUTPP (STAGE-I,II & III) - 58 m³/hr 2 KAHALGAON (STPP STAGE-I & II)	Bidder is requested to refer the amendment in this regard.
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
						- 86 m3/hr 3 FARAKKA STPP (ST-I, II & III) - 83 m3/hr 4 SINGRAULI STPP (ST-I & ST-II) - 95 m3/hr 5 RIHAND STPP-I- 41 m3/hr Hence, NTPC is requested to provide additional amount of clarified water as per system requirement furnished during detail engineering.	

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
583.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1 of 3	1.03.00	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 normal makeup water requirement. 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.	a)Please furnish the terminal point parameters like flow, pressure, temperature, etc. b)Further, since equipment cooling water system is separate for different stages as per tender, Bidder understands that from each stage of projects, normal and emergency make up is available.	Bidder is requested to refer amendment in this regard.
584.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS &	2 of 3	1.03.00	(2) Maximum quantity of Normal make up water to ECW tank of ECW system will be 2m3/hr. (3) Maximum quantity of Emergency make up to ECW tank of ECW system will be 2m3/hr.	As per tender clause 1.02.00 of SECTION-VI, PART-B,SUB SECTION: I- M5 EQUIPMENT COOLING WATER SYSTEM , Bidder has to provide separate ECW system for different stages. a)Hence, bidder understands that maximum quantity of normal and emergency make up to ECW tank	Bidder is requested to refer amendment in this regard.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 309 of 364

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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
		EXCLUSIONS				available as mentioned in tender is for each ECW system (i.e. quantity available from each stage). Please confirm Bidder's understanding.	
585.	SECTION-VI, PART -A	SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	2 of 3	1.03.00	Terminal point	Please note that service water terminal point is not mentioned in the tender. Bidder understands that one separate service water terminal point will be provided by NTPC. Please confirm.	Bidder query is not clear
586.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	3 of 51	1.03.14	2x100% centrifugal type limestone slurry pump shall be provided for each unit	Please note that as per tender, various combination of 200 and 210 MW units are provided with one (1) common absorber. In that case, Bidder understands that 2x100% centrifugal type limestone slurry pump	Bidder understanding is correct for combine absorber case where two/three units are combined together.
LOT-4 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						CLARIFICATION NO. CS-0011-109(4)-9-TECH-CLF-01 CS-0011-109(4)-9	Page 310 of 364

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						shall be provided for each absorber. Please confirm.	
587.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	34 of 51	13.02.00	2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit.	Please note that as per tender, various combination of 200 and 210 MW units are provided with one (1) common absorber. In that case, Bidder understands that 2x100% Process Water Pumps shall be provided for each absorber. Please confirm.	Bidder understanding is correct for combine absorber case where two/three units are combined together.
588.	SECTION- VI, PART -A	SUB-SECTION- III-A1 (FGD)	7 of 12	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.	Discrepancy is found in the mentioned clauses. 1) As per clause 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) whereas as per clause 15.01.00, elevator is required for absorber higher than 15 m.	Bidder is requested to refer Amendment in this regard.

**LOT-4 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM
PACKAGE**

**CLARIFICATION NO. CS-0011-
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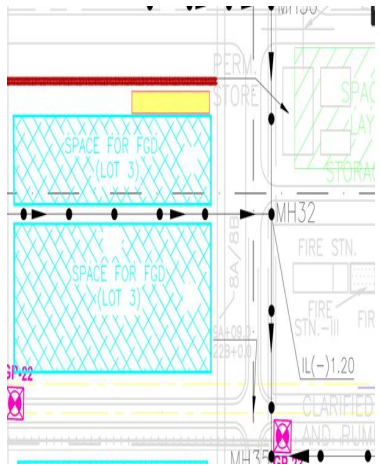
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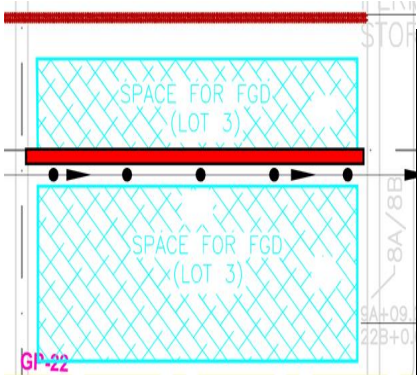
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.			
	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	37 of 51	15.01.00	(i) Type of service One (1) no. Passenger cum goods elevator per Absorber (higher than 15 m), Mill Building and Dewatering Building.	2) Also, as per clause 9.01.00, no elevator is required in dewatering building. Please note that in ongoing NTPC projects and proposals, no elevator is provided in dewatering building. Hence, Bidder has considered requirement of elevator as per clause 9.01.00 of SUB-SECTION-III-A1 (FGD).	
589.	SECTION – VI, PART -B	SUB-SECTION-I-M1 (FGD)	30 of 51	8.03.00	Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps, wherever not specified.	Please note that wherever margin on flow and head is not specifically mentioned in tender, pump parameters will be selected based on QFGDM proven practice.	Bidder is requested to comply the specification requirement

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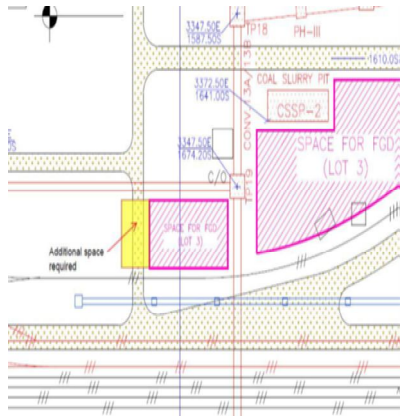
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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590.	Section-VI/Part-A	GLP (UNCHAHAR)	-	-	 Plot plan Unchahar, Area near Fuel oil Storage tank	1. Bidder requires some additional spaces (38m x 8m) near railway track as marked in yellow. Owner is requested to allow this marked-up area to be utilized for FGD facilities.	Bidder to accommodate FGD system facilities in areas earmarked for FGD Lot-IV in Tender GLP.
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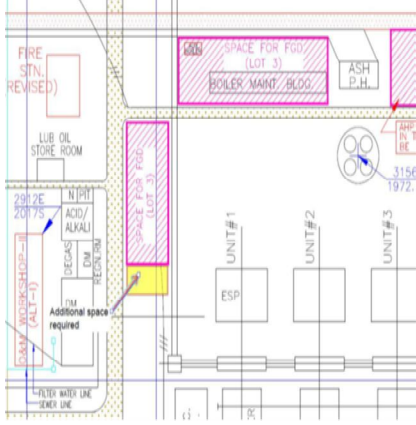
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE FOR LOT 4 PROJECTS

SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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591.	Section-VI/Part-A	GLP (UNCHAHAR)	-	-	 Plot plan Unchahar, Area near Fuel oil Storage tank	1. Existing Pipe rack is coming in marked area (Red marked). Owner to confirm existence of it and if it will remain as it is, then provide dimension drawing of Pipe rack.	Refer note 2 in GLP tender drg, the pipe rack is to be retained. Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
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592.	Section-VI/Part-A	GLP (KAHALGAON)			 Plot Plan Kahalgaon.....FGD Area Near TP-19	1. Bidder requires some additional spaces (20m x 40m) near TP-19 as marked in yellow. Owner is requested to allow this marked-up area to be utilized for FGD facilities.	Bidder to accommodate FGD system facilities in areas earmarked for FGD Lot-IV in Tender GLP.
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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593.	Section-VI/Part-A	GLP (KAHALGAON)			 Plot Plan Kahalgaon.....FGD Area Near ESP Unit#1	1. Bidder requires some additional spaces (10m x 35m) near ESP unit#1 as marked in yellow. Owner is requested to allow this marked-up area to be utilized for FGD facilities.	Bidder to accommodate FGD system facilities in areas earmarked for FGD Lot-IV in Tender GLP.

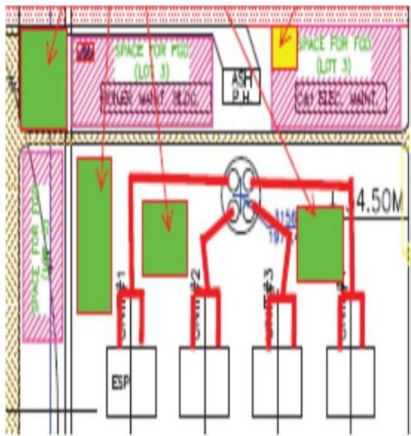
**LOT-4 PROJECTS
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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594.	Section-VI/Part-A	GLP (KAHALGAON)			 Plot Plan Kahalgaon.....FGD Area Ne	1. Bidder requires some additional spaces near Unit-1 to 4 as marked in green. Owner may please clarify/confirm that whether this marked-up area can be utilized for FGD facilities or not.	Bidder to accommodate FGD system facilities in areas earmarked for FGD Lot-IV in Tender GLP.

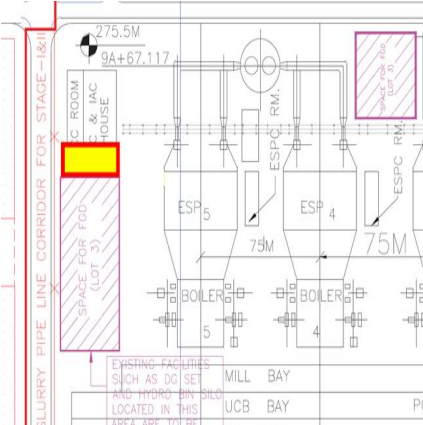
**LOT-4 PROJECTS
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595.	Section-VI/Part-A	GLP (SINGRAULI)			Plot Plan Singrauli.....FGD Area Near 	1. Bidder requires some additional spaces (8m x 36m) near ESP unit #5 as marked in yellow. Owner is requested to allow this marked-up area to be utilized for FGD facilities.	Bidder to accommodate FGD system facilities in areas earmarked for FGD Lot-IV in Tender GLP.
596.	VI / Part A	II - A1 Project information FARA KKA	27 OF 36	Annexure III	-	Soil data and foundation system section is not available in this annexure, including the information of foundation system to be adopted. Kindly provide this annexure.	Bidder is requested to refer the amendment in this regard.
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SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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597.	VI / Part A	V Salient design data	11 of 23	4.01.06	For Titanium/C-276 lining, external surface of chimney flue liner projecting over the chimney roof The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner	Based on the understand for the current FGD projects, providing a 200mm length of the capping inside the chimney is adequate. Bidder purposes to provide the same. Kindly confirm.	Bidder is requested to comply the specification requirement
598.	Section-IV, Part B	SUB SECTION-II-E1	PAGE 6 OF 8	2.09.00	PLC based control system wherever envisaged shall be provided with 100% redundancy i.e. hot standby.	Bidder understands that this clause is not applicable for proprietary OEM control systems. Please confirm.	Bidder is requested to refer the amendment in this regard.
599.	Section-IV, Part B	SUB SECTION-II-E4	PAGE 4 OF 7	2.14.04	All Cables shall be of armoured type.	Please note that cables that shall be applicable to FGD areas shall be laid in overhead trestle, Hence is safe wrt mechanical protection. Bidder propose to use unarmoured cables in entire FGD area. However, If required, Armoured cables can be provided for Directly buried cables/ cables laid in trenches or if cables are laid in handling areas- Gypsum handling and limestone handling.	Technical specification is clear and bidder to comply Technical specification.
600.	Section-IV, Part B	SUB SECTION-II-E4	PAGE 4 OF 7	2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and sizes shall be of 1Cx150, 1Cx300, 1Cx630, 3Cx150 &	Bidder request Employer not to restrict cables sizes to be used in line with mentioned sq. mm only. Bidder propose to include 3CX185 sq	Technical specification is clear and bidder to comply Technical specification.
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					3Cx240 sq.mm.	mm and 3CX300 sq mm also.	
601.	SECT ION – VI, PART -B	SUB SECT ION- II-E6	Page 3 of 27	2.01.04	No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.	Bidder understands that cable trenches can be considered in Gypsum / Limestone Handling System MCC Room/ 33kV FGD switchgear room / Control Room. Owner may please confirm.	cable vault shall be considered below the MCC and control room.
602.	SECT ION – VI, PART -B	SUB SECT ION- II-E6	Page 3 of 27	2.01.07	Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.	Bidder understands that referred clause (i.e. separate route) is applicable for Main incoming cable from Power House Building to FGD area. Due to space constraints within FGD internal area, separate route may not be feasible for redundant equipments.	Technical specification is clear and bidder to comply Technical specification.
603.	SECT ION – VI, PART -B	SUB SECT ION- II-E6	Page 3 of 27	2.01.08	For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.	Bidder understands the purchaser's cable trestle structure between Power House & FGD Area has space and load capability for fixing the bidder's cable tray (if required) for bidder's supplied cables. Bidder will not consider separate cable trestle structure between Power House & FGD Area. Please confirm.	Please note that Bidder to make a survey of existing cable trestle to accommodate mentioned cables in the existing trestle. If space is not available for laying of cables in existing trays, the new additional cable
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							trays shall be provided subject to availability of space in the trestle, otherwise separate cable trestle shall be provided for laying of cables. This is inline with Technical specification. Please also note that separate runway earthing conductor run for his scope of trays.
604.	SECTION – VI, PART -B	SUB SECTION- II-E6	Page 13 of 27	4.04.13	Separation At least 300mm clearance shall be provided between: - HT power & LT power cables, - LT power & LT control/instrumentation cables	We understand that this clause is applicable for horizontal configuration of cable trays only. Bidder proposes to provide spacing of 100 mm between different tiers of trays for vertical configuration. Please confirm.	Technical specification is clear and bidder to comply Technical specification.
605.	SECTION – VI, PART -B	SUB SECTION- II-E6	Page 26 of 27	9.00.00	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 boards shall be provided in LT switchgear room at only one floor	Bidder understands that this clause is not applicable for FGD Package. Please confirm.	NTPC Noted. Bidder understanding is correct
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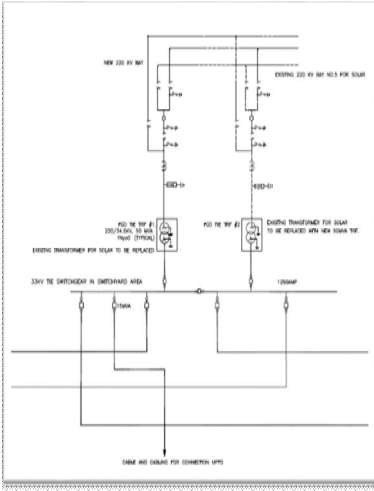
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606.	Section-VI, Part-B	SUB SECTION-II-E15 LIGHTING	7 of 18	4.00.00 ; 10 (a)	Lighting panels shall have min. IP55 degree of protection.	Bidder understands that outdoor lighting panels shall have IP55 degree of protection. However, IP54 shall be provided for indoor lighting panels. Owner is requested to confirm.	Technical specification is clear and bidder to comply Technical specification.
607.	Section-VI, Part-B	SUB SECTION-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 understand 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 specification is clear and bidder to comply Technical specification.
608.	Section-VI, Part-B	SUB SECTION-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 Control Room. Owner is requested to confirm.	Occupancy based Passive Infra-red sensors shall be used in office area, conference rooms etc. in FGD scope area.
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609.	SECTION – VI, PART -B	SUB-SECTION II-E-18 SWITCHGEAR ELECTRICAL	40 OF 65	8.07.04	Cabling in the control room shall be done on ladder type cable trays.	Bidder understand that for instrumentation cable, perforated cable tray shall be used as per clause 3.01.01 sec-IV,Part B, SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION.Kindly confirm.	NTPC Noted. Bidder understanding is correct
610.	SECTION – VI /PART-E	0011-109(3)-POE-J-001/C			<u>All Projects</u>	Please note that there shall be no FGD loads that needs 33kV voltage supply. Hence, Bidder propose to have 132 or 220/11kV transformer that shall further feed 11kV switchgear. Instead of having 33kV voltage intermediate switchgear in between. Please concur.	Bidder to comply with Technical specification
611.	SECTION – VI /PART-E	0011-109(4)-POE-J-001/C			<u>All Projects</u>	SLD indicates replacement of existing transformers with new transformers. Please note that dismantling of existing transformer/facilities shall not be bidder scope of supply.	Dismantling and relocation of existing transformers to location as directed by site in charge shall be in bidder's scope. Bidder to refer Clause no.
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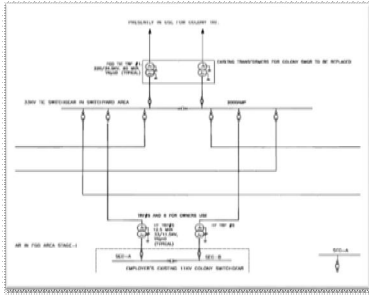
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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							1.17.00 of Sub-Section IIIB, Part A of Technical specification.
612.	SECTION – VI /PART-E	0011-109(3)-P0E-J-001/C			<u>All Projects</u>	Please note that 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 refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
613.	SECTION – VI /PART-E	0011-109(4)-P0E-J-001/E			<u>Unchahar:</u> 	NTPC to identify the location of the following Existing facilities in the plot plan: 1. Location of Existing Solar transformers which need to be replaced by new higher rating (50MVA) transformers for FGD system. 2. Space in switchyard area for 33kv switchgear room for FGD system near to the existing solar switchyard bay. 3. SLD indicates- "cable and cabling for connection upto existing 33kv solar feeder is in bidders scope." Request you to provide Location of the Existing 33KV Solar feeder terminal point. & distance from	1.), 2.), 3) Bidder may refer GLP to estimate distance between Bidder's new 33KV switchgear and existing solar 33KV feeder located in switchyard area . Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc. 4) The existing switchyard details shall be provided during detailed engg. on award of contract.
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						proposed 33kV switchgear. 4. Request employer to provide R &M, SLD, GA Layout, Erection drawings as required of the Existing 220kV Switchyard. Same is required for estimating the cost of augmentation and modification of these feeders and interfaces with existing bay and bus bar. 5. Bidder understand that for extension of 220kV bay. It is not necessary to have switchyard equipment of same make as that of existing switchyard equipment make. Please confirm.	5) Bidder understanding is correct.

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614.	SECTION – VI /PART-E	0011-109(4)-P0E-J-001/C			<u>Singrauli:</u> 	NTPC to identify the location of the following Existing facilities in the plot plan: 1. Location of Existing colony transformers which need to be replaced by new higher rating (80MVA) transformers. 2. Also the space available in (12.5MVA) existing Transformer location may be inadequate for 80MVA Transformer.Owner may please clarify the above. 3. Space and location of TRF#5 & 6 (12.5MVA) that shall feed employer's existing 11kV colony switchgear.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
615.	SECTION – VI /PART-E	0011-109(4)-P0E-J-001/C			<u>Rihand:</u>	Request employer to provide Location of the 'Employer's existing 11KV switchgear' & distance from proposed 33kV switchgear.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
616.	SECTION – VI /PART	0011-109(4)-P0E-			<u>FARAKKA</u> Note:- 5 3X50% feeding arrangement may be used for 415Volts load centers where	Please note that NOTE-5 is applicable to 415V system. However SLD indicates 3X50 % transformer configuration for 6.6kV tie switchgear	Bidder to follow technical specification requirement.
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	T-E	J-001/C			the total LT loads is more than 2.15 MVA	in FGD for stage-II & III Please clarify.	
617.	SECTION – VI /PART-E	0011-109(4)-P0E-J-001/C		Symbol. #	<u>FARAKKA</u> New 33kV FGD Tie switchgear shall be located in new switchgear building near existing stage-III 33kV switchgear building. Cables/Cabling from existing switchgear building shall be in scope of bidder. Augmentation / Modification in spare feeder of existing 33kV stage-III swgr to make it suitable shall also be in scope of bidder.	Request employer to share the drawings- GA and SLD & location of existing Switchgear of station Power loading details on existing switchgear, cable route, cable length , GA of existing 33kV switchgear buildings. Same is required for estimating the cost of augmentation and modification of these feeders.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
618.	SECTION – VI /PART-E	0011-109(4)-P0E-J-001/C			<u>KAHALGAON</u> Note:- 5 3X50% feeding arrangement may be used for 415Volts load centers where the total LT loads is more than 2.15 MVA	Please note that NOTE-5 is applicable to 415V system. However SLD indicates 3X50 % transformer configuration for 11kV tie switchgear in FGD area unit-5&6. Please clarify.	Bidder to follow technical specification requirement.
619.	SECTION – VI /PART-E	0011-109(4)-P0E-J-			<u>KAHALGAON</u> Existing 132/34.5KV, 10MVA MUW Transformers to be replaced by 132/34.5KV, 80MVA Transformer	As per NTPC site Engineer's feedback, Existing ICT of 200MVA capacity already loaded with more than 170MVA. Hence existing ICT may be inadequate to cater the load	Bidder to follow technical specification requirement.
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		001/C				of FGD system. Also the space available for 10MVA Transformer may be inadequate for 80MVA Transformer. Owner may please clarify the above.	
620.	SECTION – VI /PART-E	0011-109(4)-POE-J-001/C			KAHALGAON 33KV Tie Switchgear in Switchyard Area	As per NTPC site Engineer's feedback, construction of 33KV Switchgear building in stage-I switchyard area will be very risky as underground facilities (say HV cables) are not known to them. Hence they requested to review the Power distribution scheme again. Owner may please clarify.	Bidder to follow technical specification requirement.
621.	SECTION – VI /PART-E	0011-109(4)-POE-J-001/C			KAHALGAON 132/34.5KV, 80MVA Transformers & 33KV Tie Switchgear in Switchyard Area	Bidder requests NTPC to provide Existing Switchyard Layout drawing.	The existing switchyard layout & details shall be provided during detailed engg. on award of contract.
622.	SECTION – VI /PART-E	0011-109(4)-POE-J-001/C			KAHALGAON 33kV cable and cabling for interconnection to employer's existing 33kV MUW line bays shall be in bidder's scope	Employer to indicate the location of existing 33kV MUW line bays & distance between proposed 33kV switchgear location and existing MUW line bay.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
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623.	VI/A	IIIC	2 of 21	1.01.00 (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.	Bidder understands Fieldbus protocol is to be followed for specified type of instruments / electrical actuators which are connected to the FGD DDCMIS. Fieldbus requirement shall not be applicable for Instruments/Actuators connected to Proprietary Control system like LSU PLC, Compressor LCP, HVAC LCP, CEMS Analysers etc. The same shall be conventional hardwired type. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/A	IIIC	2 of 21	1.02.01	Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications except for Booster Fan blade pitch controls for which conventional controls and devices (Actuators, Instruments) shall be provided		
	VI/A	IIIC	11 of 21	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.		
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	VI/A	IIIC	19 of 21	12.00.00	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.		
624.	VI/A	IIIC	3 of 21	1.02.01 (G)	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 instrumentaion cables (F type/ G type), bidder's understanding is correct.
	VI/B	III-C5	18 of 23	8.03.08 (b)	Minimum 4 pair Instrumentation Cables shall be used for connection between field/JB and DDCMIS marshalling cabinet ...		
625.	VI/A	IIIC	4 of 21	2.01.00	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.	Detailed technical specification for Messaging system and wireless link is not available in Tender. Bidder understands that Messaging system and wireless link is not applicable for FGD DDCMIS. Kindly confirm / clarify.	Bidder's understanding is correct.
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626.	VI/A	IIIC	5 of 21	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 ...	Bidder understands that a common process block can be considered including all common systems like Gypsum Dewatering / handling, Limestone preparation / handling, 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)
627.	VI/A	IIIC	6 of 21	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.

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628.	VI/A	IIIC	8 of 21	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	8/9 of 21	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.		
629.	VI/A	IIIC	10 of 21	3.01.01	Primary instruments like 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),	Bidder understands that Nucleonic type density meters operating on low radiation and not requiring AERB approval, can be considered for slurry density measurement. Kindly confirm / clarify.	Bidder's understanding is not correct. Bidder to comply with the specification requirement.
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630.	VI/A	IIIC	11 of 21	3.01.03	Vibration monitoring system panel shall be placed in FGD control room.	Vibration monitoring system shall be primarily placed in FGD Control room. However, for cases where the distance between the sensor and Panel is beyond the permissible limits, Vibration Panels may be placed in nearby Remote I/O room. Kindly confirm / clarify.	Bidder's proposal is acceptable and shall be finalised during detailed engg.
631.	VI/A	IIIC	15 of 21	4.00.00	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 ... 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.	Bidder understands that Instrument racks may be provided for grouping of instruments which are located in open areas / outside covered building. Kindly confirm / clarify.	Specification requirements are clear. Bidder to comply with the specification requirement.
632.	VI/A	IIIC	15 of 21	4.00.00	All transmitters, switches, temperature transmitters etc shall be suitably grouped together and mounted inside (i) Local Instruments	Bidder understands that installation in Local Instrument Enclosure shall not be applicable for diaphragm seal type transmitters/switches. Kindly confirm /	Specification requirements are clear. Bidder to comply with the specification
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					Enclosures (LIEs) in case of open areas of the plant ..	clarify.	requirement.
633.	VI/A	IIIC	18 of 21	10.00.00	Interfacing with Employer's DDCMIS	Bidder understands that necessary hardware / software modifications / upgradation, 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	6 of 21	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.		
634.	VI/A	IIIC	18 of 21	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. Kindly confirm / clarify.	Bidder's understanding is correct in view of limestone transportation through road.
	VI/A	III-A5	2 of 12	2.01.01	Limestone will be received to power plant through road by trucks...		
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635.	VI/A	IIIC	18 of 21	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.
636.	VI/B	III-C5	3 of 23	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 channel redundancy shall be considered as specified in Volume-VIA, Sub-Section-IIIC Cl.No.2.15.00. Kindly confirm / clarify.	Bidder's understanding is correct and accordingly output redundancy shall be considered for 10% of all type of drives.
	VI/A	IIIC	10 of 21	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.		
637.	VI/B	III-C2	13 of 40	4.00.00	Level Gauge - Sensing Element - Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.	Transparent / Reflex type Level gauges may not suitable for Tank height > 3m. Bidder understands that type of Level Gauge - Transparent or Float Board type or other, may be selected as is suitable for corresponding Tank height and	Noted. However same shall be discussed and decided during detailed engineering.
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						process conditions, as per OEM's practice. Kindly confirm / clarify.	
638.	VI/B	III-C2	18 of 40	9.04.00 (1)	Rotameter - Type - Variable Area Metal tube	It is observed that Variable Area Metal tube type Rotameters are not suitable for fluids with low flow. Bidder understands that type of Rotameter may be selected as is best suitable for the corresponding process condition. Kindly confirm / clarify.	Noted. However same shall be discussed and decided during detailed engineering.
639.	VI/B	III-C2	24 of 40	11.01.00 (10)	CEMS - Common Requirements for all Analysers - Location of the analysers (other than insitu type)/Analyser Panel. - AT 0' Mtrs near stack for CEMS analysers except particulate matter analyser.	Most of Suppliers of Mercury Analysers recommend to restrict sample tubing length below 20m, to prevent sample contamination. For such cases Bidder understands that Mercury Analyser Panel (with Panel AC) may be placed at nearest Stack platform, instead of 0 Mtrs. Kindly confirm / clarify.	This shall be discussed and decided during detailed engineering.

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640.	VI/B	III-C2	33 of 40	12.00.00	Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field-programmable) for each measurement point in both horizontal & vertical planes.	As per API 670 5th edition, double integration of signals is not permissible. Accordingly, it is understood that referred clause is applicable only for velocity transducers and not for accelerometers. Kindly confirm / clarify.	Specification requirements are clear. Bidder to comply with the specification requirement.
641.	VI/B	III-C2	37 of 40	14.00.00	WATER SYSTEM RELATED SPECIAL INSTRUMENTS (PT PLANT, UFRO ETC)	It is understood that PT Plant, UFRO etc. are not included in Lot-4 Projects scope. Accordingly analysers specified in referred clauses shall not be applicable. Kindly confirm / clarify.	Bidder's understanding is correct.
642.	VI/B	III-C3	1 of 4	2.02.00	Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications.	Bidder understands that 'mill' application indicated here refers to coal mills, and the same is not applicable for Limestone Ball Mills. Kindly confirm / clarify.	Bidder's understanding is not correct. Bidder to comply with the specification requirement.
643.	VI/B	I-M6	60 of 74	4.01.00	Coal Handling Plant Main Control Room	Bidder understands that all references to 'control room' in Volume-VIB Sub-Section I-M6, shall be understood as FGD Control room. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/B	I-M6	63 of 74	4.06.00 (c)	The operation and stoppage of the paddle feeders shall be signaled in the main control room of the Lime handling plant....		
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644.	VI/B	I-M6	66 of 74	4.07.02	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	4 of 21	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.		
645.	VI/B	I-M6	67 of 74	4.08.00	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. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/B	III-C5	14 of 23	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.		
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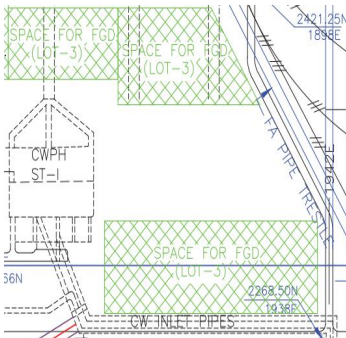
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646.	VI/B	I-M6	62 of 74	4.03.01	Graphic display status indicators associated with a particular motor/equipment shall flicker fast in case of fault / trip. In addition, emergency stop push button on the control desk for immediate shut down of complete plant shall be provided.	Bidder understands that no hardwired Graphic display / mimic lamps / push-buttons are envisaged for Limestone Handling system in the FGD Control room, inline with NIT VI-A Sub-Section-IIIC. Kindly confirm / clarify.	Bidder's understanding is correct.
	VI/B	I-M6	67 of 74	4.07.02 (m)	Further Mimic lamps for HT and LT SLDs shall be provided on the control desk.		
	VI/B	I-M6	70 of 74	4.12 (c)	Only one start/stop push button along with selector switches for various modes of operation of Lime sampling system shall be provided for automatic operation of complete lime sampling system. This control facility shall be provided at main FGD control desk as well as locally.		

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647.	VI/B	I-M6	70 of 74	4.12	(a) Lime Sampling Unit shall be controlled through PLC as per standard and proven practices of LSU equipment / LHP supplier, which will be located nearest MCC. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Suitable Mimic shall be provided for LSU. b) Lime Sampling Unit shall be interfaced (Soft and Hardwired Interface) with main FGD DDCMIS for complete control and monitoring of LSU system. Mimic shall be provided in the Operator Work Station (OWS) at main FGD control room.	(a) Bidder understands that Lime Sampling unit shall be controlled by proprietary control panel as per supplier's standard and proven practice, which shall be placed locally near the Lime Sampling Unit or nearest Remote I/O room. Kindly confirm / clarify. (b) Supervisory monitoring and control of Lime Sampling Unit shall be provided from the FGD DDCMIS. Kindly confirm / clarify. (c) LSU mimics shall be provided be provided on OWS of the FGD DDCMIS. Kindly confirm / clarify.	(a) Control panel shall be placed in the nearest MCC/ RIO room inline with specification and shall not be placed locally near LSU. (b) (c) Bidder's understanding is correct and accordingly specification requirements to be complied.
648.	VI/E	-	06 of 15	1.00.00 (B), 0000-999-POI-A-065	<i>Duplex RTD wiring termination scheme</i>	Bidder understands that wiring termination scheme indicated between 1 no. duplex RTD and Temperature Transmitter is equally applicable for 2 nos. of simplex RTDs. Kindly confirm / clarify.	Bidder's understanding is correct.
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649.	-	-	-	-	Absorber Site Fabrication	Kindly confirm, as in Lot-1A & 1B projects, the Absorber vessel can be site fabricated.	Absorber vessel can be fabricated at site. Clad Plates for Absorbers shall be considered under supply portion and Material cost for the same is to be quoted in supply portion, whereas, only site fabrication and erection cost of Absorber shall be quoted under Installation.
650.	VI/A	II-A6	32/33	General Layout Plan 1240-999-POC-F-001 (Rihand - stage 1)		1. The area adjacent to CW P ST-1, we understand that in Lot-3 it was initially allocated & later removed, we understand loose soil is the issue here, but due to FGD main block & other facilities to be at same location, bidder requests NTPC to allocate this area, kindly allocate this area, required strengthening shall be bidder. Please confirm same is acceptable to NTPC.	Bidder to accommodate FGD facilities within the areas earmarked in Tender GLP.
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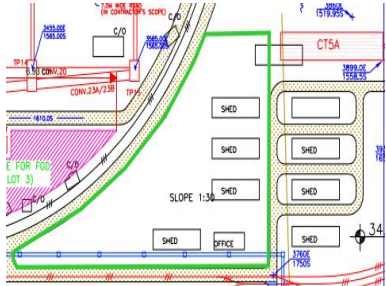
SL. NO.	SPECIFICATION REFERENCE				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC REPLY
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651.	VI/A	E/ II-A			General layout plan (1240-999-POC-F-001) / Electrical Single Line Diagram for FGD Package (Drg.no.0011-109 (4)-P0E-J-001/C(Rev B)-RIHAND	Bidder request Owner to inform the location of New 12.5 MVA Transformer on the Plant Layout. We request this information for estimation of Cable length for the power supply of Transformer.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
						Request NTPC to indicate the Location of Employer's Existing 11kV switchboard in General Layout plan.	
						Request NTPC to provide Existing switchyard control room location on Plot plan and GA drawings.	

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652.	VI/A	III-A6	11 of 32	7.02.02	The maximum allowable bearing pressure in rock shall be lower of the two values, ie as per approved geotechnical report and as per the value furnished in Table -1 Table-1 <table><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing Pressure T/m2</th></tr><tr><th colspan="2">Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata</th><th rowspan="2">Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata</th></tr><tr><th colspan="2">Width upto 6.0m</th></tr><tr><td>0.3m embedment into rock</td><td>30.0</td><td>30.0</td><td>30.0</td></tr><tr><td>0.6m embedment into rock</td><td>40.0</td><td>40.0</td><td>40.0</td></tr></table>	Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2			Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata		Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata	Width upto 6.0m		0.3m embedment into rock	30.0	30.0	30.0	0.6m embedment into rock	40.0	40.0	40.0	MHPS would like to use the actual Safe Bearing Capacity (SBC) values as per the geotechnical investigation that will be conducted at the time of exciution. And the SBC shall not be limited as per the values as given in Table -1 of clause no 7.02.02	Contractor 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-1
Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2																							
	Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata		Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata																					
	Width upto 6.0m																							
0.3m embedment into rock	30.0	30.0	30.0																					
0.6m embedment into rock	40.0	40.0	40.0																					
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653.	VI/A	II-A3	25/27	General Layout Plan (4230-999-POC-F-001 Rev.9) (Kahalgaon - Stage 1 & 2)		Bidder had made a site feasibility study for the FGD system setup and noted that there are space constraints as per the area allocated in the tender. In this regard, based on the site feedback; Bidder is aware that Area adjacent to Cooling Tower 5A (marked in Green Colour in the GLP) are free space. Hence in this regard, request the NTPC to provide the confirmation to use the same area.	Bidder to accommodate FGD facilities within the areas earmarked in Tender GLP.
654.	VI/A	E/IIA		-	General Layout Plan (4230-999-POC-F-001) and Single Line Diagram (0011-109(4)-POE-J-001/C Rev B	Upgradation of the rating for 132kV switchyard equipment like Circuit breaker, isolator, CT, etc allocated for FGD tie transformer is not in scope of Bidder. NTPC to confirm. Request NTPC to provide Existing switchyard control room location on Plot plan and GA drawings.	Bidder understanding is correct regarding the CB, isolator & CT. Bidder refer to clause no:1.05.06 & 1.17.00 regarding the scope of work. Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
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655.	VI /A	E/II-A			General layout plan (1450-001R-TGPE-PVM-F-001) / Electrical Single Line Diagram for FGD Package (Drg.no.0011-109 (4)-P0E-J-001/E(Rev B)-FGUTPP	Bidder understands that the existing connection between 1 Nos. transformer for solar connection and 220kV line bay has to be replaced by a connection between new 80MVA transformer and 220kV existing bay. Bidder will consider the feeder, cable and cable connection till the existing 33kV Transmission line location.	1)The tranformer rating is 50MVA not as 80MVA. Bidder to refer to Drg.no.0011-109 (4)-P0E-J-001/E(Rev B)-FGUTPP . 2) Technical specification is clear. Bidder to comply with Technical specification requirement.
656.						Upgradation of the rating for 220kV switchyard equipment like Circuit breaker, isolator, CT, etc allocated for FGD tie transformer#2 is not in scope of Bidder. NTPC to confirm.	Bidder understanding is correct regarding the CB, isolator & CT for FG tie Transformer#2. Bidder refer to clause no:1.05.00 & 1.17.00 regarding the scope of work.
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657.	VI/A	II-A1	23 of 49	ANNEXURE -IIISOIL DATA & FOUNDATION SYSTEM	Table – 2: Net Allowable Bearing Pressure i) <table><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing Pressure T/m2</th></tr><tr><th colspan="2">Isolated and combined footings</th><th rowspan="2">Rafts (width > 6m)</th></tr><tr><th>Width upto 3.0m</th><th>Width > 3.0m upto 6m</th></tr><tr><td>3m below FGL</td><td>8</td><td>6</td><td>7</td></tr><tr><td>4m below FGL</td><td>10</td><td>8</td><td>9</td></tr></table> The maximum allowable bearing pressure in shall be lower of the two values, ie as per approved geotechnical report and as per the value furnished in Table -2	Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2			Isolated and combined footings		Rafts (width > 6m)	Width upto 3.0m	Width > 3.0m upto 6m	3m below FGL	8	6	7	4m below FGL	10	8	9	MHPS would like to use the actual Safe Bearing Capacity (SBC) values as per the geotechnical investigation that will be conducted at the time of exicution. And the SBC shall not be limited as per the values as given in Table -2 in ANNEXURE -III	Contractor 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
Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2																							
	Isolated and combined footings		Rafts (width > 6m)																					
	Width upto 3.0m	Width > 3.0m upto 6m																						
3m below FGL	8	6	7																					
4m below FGL	10	8	9																					
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658.	VI /A	II-A1	24 of 49	ANNEXUR E -IIISOIL DATA & FOUNDATI ON SYSTEM	As per the table in ANNEXURE -II -d) and point number i) under e) the minimum length below Cut-off level is given as 23m for 600 mm diameter and 26m for 760 mm diameter . And under point number ii) of e) pile shall penetrate a minimum of 5m for 600 mm diamter and 7m for 760mm diameter in strata with SPT Greater than 40 for 600 mm diameter and 50 for 760 mm diameter. The longer of the two cases shall be followed <table><tr><th rowspan="2">Area/ Location</th><th rowspan="2">Pile Diameter (mm)</th><th rowspan="2">Minimum length of pile below cut-off level (m)</th><th colspan="3">Safe Load Capacity in</th></tr><tr><th>Vertical Comp. (MT)</th><th>Pullout (MT)</th><th>Lateral (MT)</th></tr><tr><td rowspan="2">FGD and related structures</td><td>600</td><td>23</td><td>120.0</td><td>36.0</td><td>7</td></tr><tr><td>760</td><td>26</td><td>225.0</td><td>67.5</td><td>11</td></tr></table>	Area/ Location	Pile Diameter (mm)	Minimum length of pile below cut-off level (m)	Safe Load Capacity in			Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)	FGD and related structures	600	23	120.0	36.0	7	760	26	225.0	67.5	11	MHPS Proposes to follow the length of pile shall be terminated as per caluse ii) pile shall penetrate a minimum of 5m for 600 mm diamter and 7m for 760mm diameter in strata with SPT Greater than 40 for 600 mm diameter and 50 for 760 mm diameter and length shall be fixed as per the required safe load capcity calculted according tor Geotechnical report .	Bidder to comply the Technical Specification
Area/ Location	Pile Diameter (mm)	Minimum length of pile below cut-off level (m)	Safe Load Capacity in																								
			Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)																						
FGD and related structures	600	23	120.0	36.0	7																						
	760	26	225.0	67.5	11																						

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659.	VI /A	II-A1	25 of 49	ANNEXURE -III SOIL DATA & FOUNDATION SYSTEM	For piles -Cut off level (COL) is assumed as 3 m below F.G.L	Cutt-off level of piles shall be varying and a minimum cutt off level of 1 m below FGL will be followed.	Cutt-off level of piles shall be varying and a minimum cutt off level of 1 m below FGL will be followed.
660.	VI /A	E/ II-A			General layout plan (1150-999-POC-F-001, Rev02) / Electrical Single Line Diagram for FGD Package (Drg.no.0011-109 (3)-P0E-J-001/C(Rev A)-Singrauli	Upgradation of the rating for 132kV switchyard equipment like Circuit breaker, isolator, CT, etc allocated for FGD tie transformer is not in scope of Bidder. NTPC to confirm.	Bidder understanding is correct. Also Bidder to refer to Part-A , Section - IIIB, Clause No:1.05.07.
						Owner's use 33/11.5kV, 12.5 MVA transformer protection panel location shall be mentioned	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
						Request NTPC to indicate the existing 33kV switchboard room location in the GLP. Also, request NTPC to allocate space for new 33kV switchboard building in GLP.	

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	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.																				
661.	VI /A	II-A4	12 of 31	7.02.02 OPEN FOUNDATI ON	The maximum allowable bearing pressure in rock shall be lower of the two values, ie as per approved geotechnical report and as per the value furnished in Table -1 Table-1 <table><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing Pressure T/m2</th></tr><tr><th>Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata</th><th colspan="2">Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata</th></tr><tr><th colspan="2">Width upto 6.0m</th></tr><tr><td>0.6m embedment into rock</td><td>30.0</td><td>30.0</td><td>30.0</td></tr><tr><td>1.0m embedment into rock</td><td>35.0</td><td>35.0</td><td>35.0</td></tr></table>	Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2			Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata	Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata		Width upto 6.0m		0.6m embedment into rock	30.0	30.0	30.0	1.0m embedment into rock	35.0	35.0	35.0	MHPS would like to use the actual Safe Bearing Capacity (SBC) values as per the geotechnical investigation that will be conducted at the time of exicution. And the SBC shall not be limited as per the values as given in Table -1 of clause no 7.02.02	Contractor 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-1
Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2																							
	Isolated and combined footings including raft for 12mm permissible settlement in case of rocky strata	Rafts (width > 6m) for 12mm permissible settlement in case in case of rocky strata																						
	Width upto 6.0m																							
0.6m embedment into rock	30.0	30.0	30.0																					
1.0m embedment into rock	35.0	35.0	35.0																					
662.	SECT ION – VI, PART-A	SUB-SECT ION-III-C (C&I)	Page No 1/21.	Cl. No. 1.01.00-	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	Bidder understand that RO based desalination plant in vallur (3x500MW) and water treatment plant of shimadri(4x500MW) are not applicable for this project.	Bidder's understanding is correct. Please refer amendment in this regard.																	
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					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.		
663.	SECTION – VI, PART-A	SUB-SECTION-III-C (C&I)	Page No 4/21.	Cl. No. 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 understand that 1set of common redundant processor/CPU shall be considered for all common process system. Individual separate redundant processor/CPU is not envisaged for Gypsum dewatering, Limestone preparation and handling and other associated common system. Please confirm.	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,
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							Water treatment system (as applicable)
664.	SECTION – VI, PART-A	SUB-SECTION- III-C (C&I)	Page No 5/21.	Cl. No. 2.02.03-	-----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	Bidder understand that licenses validity for the continuous service life of plant is OEM specific. Bidder will inform client with prior intimation against obsolesce/expiry of licenses. Bidder requested to modify this clause suitably.	Bidder to comply to specification requirement.
665.	SECTION – VI, PART-A	SUB-SECTION- III-C (C&I)	Page No 7/21.	Cl. No. 2.05.00-	Data Communication System	Bidder understand that VFDs, package PLCs i.e. compressor, UPS etc shall be connected with FGD DDCMIS system in redundant mode through redundant cable. Please confirm.	Soft connectivity of VFDs, package PLCs is not envisaged in this specification. However hardwired connectivity shall be finalised during detailed engineering. For soft connectivity of UPS and charger, bidder to refer clause 1.01.03, PART-B sub section IIIC-10.

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666.	SECTION – VI, PART-A	SUB-SECTION-III-C (C&I)	Page No 13/21.	Cl. No. 3.03.01-	9. Analyzers mentioned in Sl.No. 1 to 7 of the above list of flue gas analyzers for CEMS are not applicable for NSPCL Rourkela (1x250MW) project.	Bidder understand that this clause is not applicable for this project.	Bidder's understanding is correct. Refer amendment in this regard.
667.	SECTION – VI, PART-A	SUB-SECTION-III-C (C&I)	Page No 16/21	Cl. No. 5.01.00(d)-	Cables required for interfacing FGD DDCMIS with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's scope.	Bidder understand that redundant FO cable from FGD DDCMIS Network switch (located in FGD Main control room/ECR) shall be terminated only at the particular set of network switch of Main CCR Control room for establishment of soft connectivity with Employer's DDCMIS. Separate redundant FO cable is not envisaged for SG and BOP. For Hardwired connectivity, only provision of IO will be kept in RIO Panel (of FGD system) located in main CCR along with necessary cable for hardwired connection. Please confirm.	Bidder to comply to specification requirement.
668.	SECTION – VI, PART-A	SUB-SECTION-III-C (C&I)	Page No 16/21	Cl. No. 5.01.00(e)-	Cables for connectivity of CEMS signals to Employer's Unit DDCMIS located in unit CER shall be in bidder's scope.	Bidder understand that separate cable connectivity from CEMS Panel to Employer's DDCMIS located in unit CER is also required apart from CEMS Panel connectivity with FGD	It is clarified that Hardwired connectivity of CEMS signals to employer's Unit DDCMIS located in unit CER is
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		-Cl. No. 5.01.00(e)-Page No 16/21				DDCMIS located in FGD ECR Building. Please confirm. Cable connection shall be hardwired based or soft connectivity. Please clarify.	envisaged.
669.	SECTION – VI PART-B	SUB-SECTION-III-C2	Page No-3/40	Cl No-2.01.00-	Sl No: 14-Accessories: For hazardous area, enclosure as described in NEC article 500	Bidder understand that FGD is a safe area so standard normal instruments shall be used. Please confirm.	Bidder's understanding is generally correct.
670.	SECTION – VI PART-B	SUB-SECTION-III-C2	Page No-7/40	No-2.04.00-	Sensor Material: Corrosion resistant material to suit individual application requirement	Bidder requested to indicate sensor material for slurry application.	Specification requirement is clear.
671.	SECTION – VI PART-B	SUB-SECTION-III-C2	Page No-8/40	No-2.05.00-	Sensor Material: Corrosion resistant material to suit individual application requirement Liner: Hard rubber or better material to suit the actual application.	Bidder requested to indicate sensor material and liner details for slurry application.	Specification requirement is clear.
672.	SECTION – VI PART-B	SUB-SECTION-III-C2	Page No-11/40	No-3.04.00-	Thermo well (for all process temp. elements): Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC	Bidder understand that IL(insertion length) more than 500mm, Fabricated thermowell is also acceptable. Less than and up to 500mm of insertion	Bidder's proposal is not acceptable.
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	T-B				19.3, 1974)	length, Drill bar stock thermowell will be provided.	
673.	SECTION – VI PART T-B	SUB-SECTION- III-C2	Page No- 16/40	No- 9.00.00-	SPECIFICATION FOR FLOW ELEMENTS	Bidder understand that Annubar/Sapber is acceptable for Flue gas flow measurement. Bidder requested to clarify any other type flow element like aerofoil is required for this application or not.	Selection of flow element depends on process application and shall be discussed and decided during detailed engineering.
674.	SECTION – VI PART T-B	SUB-SECTION- III-C4	Page No- 10/13	CI No- 8.05.00-	The cables emanating from redundant equipment/devices shall be routed through different paths.	Bidder understand that cables of redundant equipment/devices shall be routed in separate tray/conduit. In case non availability of different paths in site, redundant cable shall be laid in same route with different cable tray/conduit is also acceptable and the same shall be mutually finalized during engineering. Please confirm.	Noted. However same shall be discussed and decided during detailed engineering.
675.	SECTION – VI PART T-B	SUB-SECTION- III-C5	Page No-9/23	CI No- 4.01.10	Independent and dedicated controllers (main and its 100% standby) shall be provided for each of the functional group (FG) of Control System except for the cases where triple redundant controllers are to be used as per this specifications.	Bidder understand that triple redundant controller is not applicable for FGD system. Dual redundant controller (main and its 100% standby) shall be only applicable. Please confirm.	Bidder's understanding is correct.
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676.	Part A, Section VI	Sub Section IIIB,	Pg 2/13,	Cl.No. 1.05.00.i FGUTPP Stage I, II, III		Layout (plan & section) & Protection SLD for existing 220kV switchyard required	This details will be provided during detailed engineering stage on award of contract
677.	Part A, Section VI	Sub Section IIIB	Pg 2/13,	Cl.No. 1.05.00.i FGUTPP Stage I, II, III		During site visit the space is available for control panel of new 220 KV bays. Please confirm whether we can utilise the space or place our panel in our 33 KV switchgear room.	The control panel of new 220KV Bay shall be placed in existing switchyard control room.
678.	Part A, Section VI	Sub Section IIIB	Pg 10/13,	Cl.No. 1.17.00.3 FGUTPP Stage I, II, III		Location of existing solar transformer to be replaced required– as per site information it will 5 th bay.	Bidder understanding is correct.
679.	Part E	Tender Drawing,		SLD No. 0011-109(4)-POE-J-001/E, Rev.B		Location of existing 33kV solar feeder upto which cabling is to be considered required. Please confirm the existing cable will be used through jointing or not.	Bidder to note that use of existing cable with jointing is not envisaged.
680.	Part A, Section VI	Sub Section IIIB,	Pg 11/13,	Cl.No. 1.17.00.1 Rihand Stage I		Layout (plan & section) & Protection SLD for existing 132kV switchyard required	This details will be provided during
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681.	Part A, Section VI	Sub Section IIIB,	Pg 11/13,	Cl.No. 1.17.00.1 Rihand Stage I		Details of existing 132kV Rihand Singrauli line bay which has to be equipped required.	detailed engg. stage on award of contract.
682.	Part A, Section VI	Sub Section IIIB,	Sub Section Pg 12/13	Sub Section Cl.No. 1.17.00 Rihand Stage I Pt. No. 2		Space is available in switchyard for new 33kV switchgear room but area is slightly different.	Bidder may refer GLP. Bidder may also visit the project in order to get itself acquainted with existing electrical plant/facilities etc.
683.	Part A, Section VI	Sub Section IIIB	Pg 12/13, Cl.No. 1.17.00 Rihand Stage I Pt. No. 4	Cl.No. 1.17.00 Rihand Stage I Pt. No. 4		Please confirm 33KV/11KV transformer to be located in the switchyard only.	
684.	Part A, Section VI	Sub Section IIIB,	Pg 12/13, Cl.No. 1.17.00 Rihand Stage I Pt. No. 4	Cl.No. 1.17.00 Rihand Stage I Pt. No. 4		Location of employer's 11kV switchgear upto which cable is to be laid required. Please indicate the location in the drawing.	

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685.	Part A, Section VI	Sub Section IIIB	Pg 3/13,	Cl.No. 1.05.04.iii Rihand Stage I		During site visit the space is available for control panel of new 132 KV bays. Please confirm whether we can utilise the space or to be placed in our 33 KV switchgear room.	The control panel of new 132KV Bay shall be placed in existing switchyard control room.
686.	Part A, Section VI	Sub Section IIIB,	Pg 3/13,	Cl.No. 1.05.04.iii Rihand Stage I		There is no SAS system in your existing 132KV system. Please confirm our SAS system for 132 KV bay is a standalone one.	NTPC Noted. The same shall be finalised during detailed engineering stage.
687.	Part A, Section VI	Sub Section IIIB	Pg 11/13,	Cl.No. 1.17.00.1 Singrauli Stage I, II		Layout (plan & section) & Protection SLD for existing 132kv switchyard required	This details will be provided during detailed engineering stage on award of contract.
688.	Part A, Section VI	Sub Section IIIB	Pg 11/13,	Cl.No. 1.17.00.1 Singrauli Stage I, II		During site visit only one colony transformer is visible in switchyard. Please indicate the location of other colony transformer in switchyard drawing.	Employer's colony transformers are located in switchyard area
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689.	Part A, Section VI	Sub Section IIIB,	Pg 11/13,	Cl.No. 1.17.00.4 Singrauli Stage I, II		Please confirm as 11KV colony substation is in the switchyard area, the colony transformer will be installed in the switchyard only.	only. The control panel of new 132KV Bay shall be placed in existing switchyard control room.
690.	Part A, Section VI	Sub Section IIIB	Pg 5/13,	Cl.No. 1.06.00.b Singrauli Stage I, II		During site visit the space is available for control panel of new 132 KV bays. Please confirm whether we can utilise the space or place our 132 KV Control panel in our 33 KV switchgear room.	
691.	PLOT PLAN	Tender Drawing		Drg. No.: PE-DG-401-100-M001, R-11		- Area indicated for FGD opposite to the fire station has an over- head tank , pump house, Fire drill ground with tower. Please confirm all structure will be dismantled by NTPC. Please provide the formation level for this are - Please provide the formation level and tentative co-ordinates for all area marked for FGD. - Area marked for FGD along the rail yard and the side of fire station has conveyor, Steam pipe line, fire pipe line, please marked the	Identified area has been allocated for FGD facilities. However, as marked in the Tender GLP overhead tank & CMBs shall be retained. Required details to be obtained from the site visit. Required drawings have been provided in the tender. However, detail drawing will be provided
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						same in the drawing and provide the elevation drawing for conveyor. - Area for FGD marked along the TP28 & 29 marked conveyor has cable trestle in front of the area, please provide the elevation of the same. - Please indicate blowdown water tapping point/ route in the layout drawing	to bidder in case of award based on availability. Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability. Indicative routing of CWBD piping has already been shown in the tender GLP in St-III area (within Block area 16B+00 to 17B+11 and 11A+00 to 15A+00). However, Terminal point location shall be as per Sub-Section-IV/Part-A/Section-VI of Technical specification. Further, required details to be obtained from the site
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692.	GENERAL LAY OUT PLAN	Tender Drawing		Drg. No.: 1240-999-POC-F-001, R-8		- Area marked for FGD near STP is a dumping ground with an elevation varies approx. 12 Mtr to 7 Mtr for surrounding land. Please confirm the formation level of the area. - Please provide the formation level and tentative co-ordinates for all area marked for FGD. - Area in front of Unit #1, marked for FGD has an existing MCC Building. As per site information it will be remain unchanged. Please confirm the same.	visit. Allocated area for FGD plant, after clearing plant waste, shall be available for bidder. However, filling in this area shall, if required from existing ground level after clearing plant waste, to proposed FGL is in Bidder scope. Please refer revised GLP Existing MCC room shall be retained in the mentioned area. Bidder to refer revised Tender GLP.
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						- Area allotted for FGD has lot of existing structure, Please confirm that it will be dismantled by NTPC. - Please provide us existing flue duct elevation drawing for all units.	Bidder is requested to adhere to the provisions of th Bid Documents Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability.
693.	GENERAL LAYOUT PLAN	Tender Drawing	Drg. No.: 1150-999-POC-F-001, R-2	Drg. No.: 1150-999-POC-F-001, R-2		- Layout (plan & section) & Protection SLD for existing 132kV switchyard - During site visit only one colony transformer is visible in switchyard. Please indicate the location of other colony transformer in switchyard drawing. - Please confirm as 11KV colony substation in the switchyard area, the colony transformer will be installed in the switchyard only. - During site visit the space is	Rely has been furnished against the respective query separately project wise. Bidder is requested to refer the clarification reply
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						available for control panel of new 132 KV bays. Please confirm whether we can utilise the space or place our 132 KV Control panel in our 33 KV switchgear room.	
694.	GTR					"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". You are requested to please confirm whether, disposal of excessive excavated material outside the plant premises is in the scope of contractor or not?	Owner will help by providing support like any letter, NOC etc for getting permission or clearance.
695.	IV-GCC		31 of 68	20.3	Approval/Review of technical documents by Project Manager	Considering the tight schedule in the project, bidders request to NTPC to reduce the documents review cycle from 21 days to 7 days.	NTPC will review Bidder's request.
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						In addition , bidders also request to maintain the 7 days review/approval cycle to all the documents	
696.	Section-VI (Part-A) Terminal Points & Exclusions	IV	3 of 3	2.00.00	Exclusions:	We understand that disposal of Gypsum/bi-products outside plant boundary is excluded from Contractor's scope. Please confirm.	Bidder understanding is correct
697.	Section-VI	(GTR) (Part-C)	38 of 83	26.02.00	Initial Operation	We request to add the following under said clause: (e) The maximum number of interruptions attributable to Contractor shall be six (6) not exceeding four hours duration.	Bidder is requested to comply requirement of technical specification
698.	Section-VI	Part-E			Singrauli	1) Please provide elevation drawing between TP-5,6 & 14.	1)Required drawings have been provided in the tender. However, detail drawing will be provided to
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						2)Area allotted for FGD in front Unit #1,2,3 has lot of existing structure & confirm that it will be dismantled by NTPC. 3) Please provide us existing flue duct elevation drawing for all units. 4) Area marked for FGD ta the end Unit#5 ESP contain some under construction foundation except MCC room and road for entering to plat. Please indicate the clear location with tentative co-ordinates. 5) Please provide the formation level and tentative co-ordinates for all area marked for FGD.	bidder in case of award based on availability. 2) Area is allocated for FGD. However, bidder to refer Note sl. no.-5 of Tender GLP. 3)Required drawings have been provided in the tender. However, detail drawing will be provided to bidder in case of award based on availability. 4) Bidder may plan the FGD facilities retaining the specified owner facilities mentioned in Tender GLP. 5)Required details to be obtained from the site visit.
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	TITLE: KAHALGAON- ST I & II (4X210 MW + 3X500 MW) FGD SPECIFICATIONS FOR RCC CHIMNEY	SPECIFICATION NO. PE-TS-481-620-C002
		VOLUME : IIB
		SECTION : D
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KAHALGAON- ST I & II (4X210 MW + 3X500 MW) **FGD SYSTEM PACKAGE**

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – D GENERAL TECHNICAL REQUIREMENTS

(RCC CHIMNEY)

SPECIFICATION NO. PE-TS-481-620-C002
REV-00



Bharat Heavy Electricals Limited

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

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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.

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SECTION	DESCRIPTION

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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

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Sub-section D22: Levelling and grading

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 WORKS

Section-C & SECTION-D CHIMNEY ELEVATOR WORKS

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SECTION-D

GENERAL TECHNICAL REQUIREMENTS (RCC CHIMNEY)



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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



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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.

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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 material is mostly rock and if filling with the same is permitted by the engineer engineer in writing, then the filling with rock shall be done in the following



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manner. The boulders shall be broken into pieces not exceeding 150mm size in 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 / 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



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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. 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



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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 ;
- 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



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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 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



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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 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 be excavated to the full depth unless construction is imminent. The last 150mm 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,



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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.

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.



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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 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



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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.

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



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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 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.



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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.
- 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.



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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. 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



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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

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.



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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

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.



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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 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.



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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.

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.



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f) 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, 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 excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work 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, 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 excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work in the schedule of quantities).

e) IN TRENCHES FOR BURIED PIPES & CABLES

Width of Trench

i) Upto one metre depth the authorized width of trench for excavation



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shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/ collar) cable, conduit etc. Where a pipe is laid on concrete bed/ cushioning layer, the authorized width shall be the external diameter of pipe (not socket/ collar) plus 25 cm or the width of concrete bed/ cushioning layer whichever is more.

ii) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils the sides of the trenches shall be kept vertical upto depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom. Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored up as directed by the Engineer-in-Charge. However, any additional excavation beyond the limit specified for firm soil herein shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities as these are deemed to be included in item of work in the schedule of quantities.

iii) Where more than one pipe, cable, conduit etc, are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

f) 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.

g) 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.

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



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BACKFILLING

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i) 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.

j) Special dewatering of ground water by well point method and side protection work by sheet piling 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, back-filling and compaction shall be submitted along with the tender.

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.



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CEMENT CONCRETE (PLAIN &
REINFORCED)**

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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**



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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



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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.



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- 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.



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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 Performa, 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



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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



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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



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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



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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.



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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



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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



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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



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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.



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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:



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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



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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



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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.



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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



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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.



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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



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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.



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- 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,



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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



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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



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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.



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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



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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.



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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 reproping 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.



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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



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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



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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



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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



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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



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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



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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.



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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



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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.



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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



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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



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- 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.



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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



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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



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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



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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.



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- 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.



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- 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



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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:



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- 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.



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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



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- 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



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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



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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



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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



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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.



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- 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

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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



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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 or 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.



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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.



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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.



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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,



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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.



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**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**



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**ROOF AND UNDERGROUND WATER PROOFING,
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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



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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.



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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.



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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.)



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- 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.



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- 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%



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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



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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:



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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



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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.



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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.



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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.



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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

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**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

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ATTACHMENT

ANNEXURE – A	SCHEDULE OF FIXTURES	12

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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.

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2.02.00 2.02.01	Fabrication 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.	

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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.		

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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.

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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.

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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.

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	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.	

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5.00.00	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. 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. <table border="0"> <tr> <td>Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)</td> <td>-</td> <td>IS: 733</td> </tr> <tr> <td>Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose)</td> <td>-</td> <td>IS: 1285</td> </tr> <tr> <td>Steel doors, windows, and ventilators</td> <td>-</td> <td>IS: 1038</td> </tr> <tr> <td>Steel windows for industrial, building</td> <td>-</td> <td>IS: 1361</td> </tr> <tr> <td>Aluminium doors windows, and ventilators</td> <td>-</td> <td>IS: 1948</td> </tr> <tr> <td>Aluminium windows for industrial buildings</td> <td>-</td> <td>IS: 1949</td> </tr> <tr> <td>Steel doorframes</td> <td>-</td> <td>IS: 4351</td> </tr> <tr> <td>Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.</td> <td>-</td> <td>IS: 1081</td> </tr> <tr> <td>Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type</td> <td>-</td> <td>IS: 3614</td> </tr> <tr> <td>Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification</td> <td>-</td> <td>IS: 7452</td> </tr> </table>	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	
Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733																														
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TITLE:

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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.



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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 locks 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.

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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		



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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 assemblies - 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.

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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

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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

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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.

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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.

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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.	



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ROLLING STEEL SHUTTERS AND GRILLS

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

**TITLE:**
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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.

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	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	

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	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".	



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MISCELLANEOUS METAL

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PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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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.

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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.	



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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.



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- 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



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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



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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



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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.



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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'



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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.



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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.



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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.



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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.



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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.



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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.



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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.



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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.



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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.



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



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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.



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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.



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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



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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.



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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



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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.



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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.



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Project Engineering Management
PPEI Building, Power Sector,
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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.



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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.



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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.



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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.



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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.



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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.



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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



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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.



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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.



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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 (I & II)	Code of Practice for painting of ferrous metal in buildings.



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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.

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Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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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.

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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	

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	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.	

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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		

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	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.	

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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 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 the 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 had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.			

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	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	

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	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.	

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	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 smoothened 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	

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	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	

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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		

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	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).	

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	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.	

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	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-	

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	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.	

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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		

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2.02.07	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. 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	

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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: - Level, Slope, Plumb as the case may be - Pattern and Symmetry - Alignment of joints, dividing strip etc. - 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
4.00.00	e) Surface finish f) Thickness of joints g) Details at edges, junctions etc. h) Performance i) Precautions specified for durability I.S. 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.	

 BHEL Bharat Heavy Electricals Limited 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 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

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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

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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.

TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING

SHEET 4 OF 6

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.

- 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.

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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 PVF ₂ 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.	

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	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

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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

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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,

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	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: - Plaster of Paris board (decorative) - Expanded polystyrene insulation board with plastic fascia. - Fibre Insulation board. - Bonded wooden particle board (Plain and decorative) - Glass fibre reinforced polystyrene sheets. - 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.	

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	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 reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features. - Typical Intermediate framing for support where required. - Hanger fastening details. - Panels - unit support at ceiling penetrations. - Details of splicing method for main and cross runners. - A table indicating load bearing capacity of main and cross runner - A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.	

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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	
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

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**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

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TITLE:

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SPECIFICATION NO. PE-TS-999-600-C015

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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 confirming 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.



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**TECHNICAL SPECIFICATION
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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.



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TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION

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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.



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TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION

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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.

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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.

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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.	

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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	

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	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: <table> <tr> <td>100 mm nominal dia.</td><td>:</td><td>1 in 35</td></tr> <tr> <td>150 mm nominal dia.</td><td>:</td><td>1 in 65</td></tr> <tr> <td>230 mm nominal dia.</td><td>:</td><td>1 in 120</td></tr> <tr> <td>300 mm nominal dia.</td><td>:</td><td>1 in 200</td></tr> </table> 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	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	
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												



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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.

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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.	



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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.



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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.



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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.

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	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	

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	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.	

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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.	



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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.

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	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 and 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 : 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	

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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.	

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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”.	

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ROAD AND DRAINAGE**

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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

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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.

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

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

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

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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	$\pm 10\text{ mm}$



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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

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5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8
6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6
8.	Semi-dense carpet	10	-	-	-	20***	6
9.	Asphaltic Concrete	8	-	-	-	10***	4

Notes:

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3.00.00 Execution

3.01.00 Setting Out

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.

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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.	

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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 skews/curves. 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.

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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	

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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.

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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

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	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.	SHEET 13 OF 36

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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	

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	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.	



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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.

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	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 recompacted. 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.	



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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.



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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.



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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

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	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.	

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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.

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	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.	

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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.



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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.

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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.		

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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

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	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.	

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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.

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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		

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	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.	

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3.12.03	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. 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	

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	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	

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	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	

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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.		

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	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**

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SECTION - D (PART I)

SUB-SECTION – D 17

FABRICATION OF STRUCTURAL STEEL WORK



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Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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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.

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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							

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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 locknuts (Dia, range 6 to 39 mm) IS: 1367 - Technical supply conditions for threaded fasteners IS: 1442 - Covered electrodes for the metal arc 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					

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	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	

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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	

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	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	

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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.	

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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.				

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2.08.10	Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.				
2.08.11	The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.				
2.08.12	Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.				
2.08.13	All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two: (a)Two coats of red lead primer and two coats of black enamel finish paint. (b) Hot dipped galvanization at 610 gm/sq.m. in the shop prior to erection at site, as the approved drawing.				
2.08.14	Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.				
2.08.15	Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.				
2.09.00	GALVANIZATION OF GRATINGS				
2.09.01	Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15				
2.09.02	After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).				
2.09.03	The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.				
2.09.04	The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter that is loosely attached to				

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	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 415M having the following chemical composition shall be used. <table> <thead> <tr> <th>Material</th> <th>%</th> <th>Remarks</th> </tr> </thead> <tbody> <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> </tbody> </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%		
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2.10.02	Fabrication																			
The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.																				
2.10.03	Fabrication Drawings																			
a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly, the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also require adjustment in the size of each element of hopper plate and also additional weld joints.																				
b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner’s store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner’s store																				

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	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	

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	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	

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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.					

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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.	

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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

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	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	

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	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	

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	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. 3.02.02 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 the 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	

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	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.	

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	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	

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	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.	

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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.				

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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.	

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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.	

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3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested 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 & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken

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	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.	

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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.	

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	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.	

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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

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	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.	

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	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.	

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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.	

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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.		

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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 unblazed 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.

6.01.18	The bidder's rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.
6.01.19	The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, materials, fabrication, grinding & finishing, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner shall supply no material for this item of work.
6.02.00	MODE OF MEASUREMENT
6.02.01	The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer.
6.02.02	The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below.
6.02.03	For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section.
6.02.04	Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However, deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06.
6.02.05	For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made).
6.02.06	For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted

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	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.	

6.02.16	The measurement for the item of permanent bolts with nuts and washers 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, and as per the approved bolts and nuts schedules.
6.02.17	The measurement for the item of High Strength Structural bolts with nuts and washers 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, and as per the approved bolts and nuts schedules.
6.02.18	The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below
6.02.19	For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured.
6.02.20	For the work of addition to, alteration in and / or modification of 'erection marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark.
6.02.21	For re-erection the weight of the modified erection mark shall only be measured.
6.02.22	The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel.
6.02.23	The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings.
6.02.24	The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate.
6.02.25	The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer.

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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.	

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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

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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.

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	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 o the Engineer.	

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2.05.00 2.05.01 2.05.02 2.06.00 2.06.01 2.06.02	Material 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. 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. Storage of Materials 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. 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.	

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.

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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.	

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	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	

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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

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	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	

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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	

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	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	

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	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.	

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	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 <table> <tr> <th>Component</th><th>Description</th><th>Variation Allowed</th></tr> <tr> <td>1.</td><td>2.</td><td>3.</td></tr> <tr> <td>Main columns</td><td>a) shifting of column axis at foundation level with respect to building line</td><td></td></tr> <tr> <td></td><td>i) In longitudinal direction</td><td>i) ± 3.0 mm</td></tr> <tr> <td></td><td>ii) In lateral direction</td><td>ii) ± 3.0 mm</td></tr> <tr> <td></td><td>b) Deviation of both major column axis from vertical between foundation and</td><td></td></tr> </table>	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		
Component	Description	Variation Allowed																		
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	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.	

TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK

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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.

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.

After award of the Contract

After award of the contract, the Contractor shall submit the following:

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.

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

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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

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 BHEL 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.		

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	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.	

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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	

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	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.	

 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 7 OF 7
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 all wastage. 6.02.00 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

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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

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<u>FALSE FLOORING</u> 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.		

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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	

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	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.	

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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

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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

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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.

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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.	

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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/M ³ 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.	

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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.

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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.	

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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

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	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.	

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.

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	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.	

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	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	

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	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.	

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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) 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. b) 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	

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	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: - 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. - 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. - 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. - 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. - 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. - More than one recording of signals shall be done until repeatability of signals is achieved on the same pile. - 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	

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	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.	

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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,

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	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	

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	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.	



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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

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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.

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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.

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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.

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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 -

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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.



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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**

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SITE LEVELLING & GRADING WORKS

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

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3.00.00	MATERIALS	4
4.00.00	QUALITY CONTROL	6
5.00.00	EXECUTION	6
6.00.00	RATES AND MEASUREMENTS	15

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GENERAL TECHNICAL SPECIFICATION FOR SITE LEVELLING AND GRADING 1.00 GENERAL This specification covers the works to be carried out for “Site Levelling and Grading Works including Slope Protection” etc. for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be. 2.00 SCOPE 2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also includes supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc. 2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof. 2.03 Work 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) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc. required for the completion of the work. b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc.) to the engineer for approval. c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer. 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.		

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

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For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.

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	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	

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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

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

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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

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	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	

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	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.	

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* 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		

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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.		

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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	

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	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	

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	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.	

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

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The contractor shall provide proper approaches for workmen and inspection.

Full scale 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 edges of excavations and fills.

6.01 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 sections 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.

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.

Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS:1200, Part-1 shall be applicable.

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 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 cutting shall be computed from these levels in cubic meter.

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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

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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:**

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FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-999-600-C023

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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.											
<table><tr><td>Chemicals</td><td>Concentration by Weight, Percentage</td></tr><tr><td>Chlorpyrifos Emulsifiable (IS 8944 - 1978)</td><td>: 1.0</td></tr><tr><td>Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)</td><td>: 0.5</td></tr><tr><td>Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)</td><td>: 1.0</td></tr></table>				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
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.	

 BHEL Bharat Heavy Electricals Limited	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.	

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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

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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		1. EARTH WORK a) Earth Fill Material (Before Compaction) b) Earth Fill Material (After Compaction)	
Item/Components			

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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	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	-	Y		
Setting Time	13		-	-	Y	-	-		
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		

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CIVIL & STRUCTURAL WORKS													
Remarks/Frequency of Test	* These tests shall be carried out, incase of doubt regarding grade of concrete due to poor workmans-hip based on results of cube strength.												
Load test on structures as per IS: 456 & core test	.	.	.	.	.	.	.	.	.	.	Y*	.	.
Water tightness test as per IS: 3370 & Is: 6494	.	.	.	.	Y	.	.	Y	.	.	.	.	.
All Tests as per Indian/International Standard/ BHEL Tech. Spec.	Y	Y	Y	Y	Y	Y	Y	Y	.	Y	Y	Y	Y
Core Test	.	.	.	.	.	.	.	.	.	Y	.	Y	.
Ultrasonic Test	.	.	.	.	.	.	.	.	.	.	.	.	.
Verticality all	.	.	.	.	.	Y	.	.	.	.	.	Y	.
Work man ship	.	.	.	.	.	Y	.	.	.	.	.	.	.
Water Retentivity as per IS: 2250	.	.	.	.	Y	.	.	.	.	.	.	Y	.
Consistency as per IS: 2250	.	.	.	.	Y	.	.	.	.	.	.	.	.
Warpage	.	.	.	Y	.	.	.	.	.	.	.	.	.
Effloresces	.	.	.	Y	.	.	.	.	.	.	.	.	.
Water Absorption	.	.	.	Y	.	.	.	.	.	.	.	.	.
Compressive Strength	.	.	.	Y	Y	.	.	.	.	.	.	.	.
Plumb	.	Y	.	.	.	Y	.	.	.	.	.	.	.
Cutting tolerances	.	.	Y	.	.	.	.	.	.	.	.	.	.
Placement	.	.	Y	.	.	.	.	.	.	.	.	.	.
Dimensions	.	Y	Y	Y	.	.	.	.	.	.	Y	.	Y
Physical & Chemical Properties	.	.	Y	.	.	.	.	.	.	.	.	.	.
Cleanliness	.	Y	.	.	.	.	Y	.	.	.	.	.	.
Visual Exam.	Y	Y	Y	Y	.	Y	.	.	.	.	Y	.	Y
Joint Adequacy	Y	.	.	.	.	.	.	.	.	.	.	.	.
Durability, strength an soundness	Y	.	.	.	.	.	.	.	.	.	.	.	.
Test Requirement Checks Item/Components	3. Form Work a) Staging b) Shuttering 4. Reinforcement 5. Bricks 6. Mortar 7. Masonary 8. Water Supply & sanitary items 9. Water retaining structures (Tank/reservoir etc.) 10. Roof water proofing 11. RCC structures 12. Doors Windows 13. Pre-cast concrete members 14. All bought out items Approval by BHEL												

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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	

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CIVIL & STRUCTURAL WORKS										
Warpage	16	-	-	-	-	-	-	Y	Y	
Comp. Strength, bond strength working, time, chemical resistant	15	-	-	-	-	-	-	Y	Y	
Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD	14	-	-	-	-	-	-	Y	-	
Positioning and location of laps and plumb level	13	-	-	-	-	Y	-	-	-	
Storage	12	-	-	-	-	Y	-	-	-	
Tests as per BHEL tech spec. and IS: 8183	11	-	-	-	Y	-	-	-	-	
Check type of permanent colour coating	10	Y	Y	Y	-	-	-	-	-	
Galvanizing test as per IS code	9	Y	-	Y	-	-	-	-	-	
Check for coating of silicon modified polyester paint thickness	8	-	Y	Y	-	-	-	-	-	
Dimensional conformity	7	-	Y	Y	Y	-	-	Y	-	
T.Cs for fasteners & 'Z' spacers	6	Y	-	-	-	-	-	-	-	
Appearance	5	Y	-	-	-	Y	-	-	-	
Sides end laps	4	Y	-	-	-	Y	-	-	-	
Fixing of decking sheets	3	Y	-	-	-	-	-	-	-	
Dimensional, thickness, depth of valley etc.	2	Y	-	-	-	-	-	-	-	
T.Cs for Physical & Chemical properties	1	Y	Y	-	-	-	-	-	-	
Test Requirements		17. Roof Decking sheets (Supply and fixing) 18. Wall Cladding work a) Outer sheet b) Inner sheet c) Insulation d) Fixing of wall cladding 19. Acid Resistant Lining a) Acid resistant Bricks/Tiles b) Acid resistant Mortar								



TITLE:

RCC STACK

SPECIFICATION NO. PE-TS-999-620-C002

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

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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.

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- 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.

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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.

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(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.			

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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		

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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**

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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

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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

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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 mechned 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

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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

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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.

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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

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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.

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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.

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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

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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:



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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

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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.

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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

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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.

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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.

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- 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.

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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.

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- 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.

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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

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reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a separate 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 unsafe 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

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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.

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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

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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

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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.

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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.

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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

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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

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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.

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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.

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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

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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.

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- 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**

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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:

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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.

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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.



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- 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



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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



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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.



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- 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.

**TITLE:****CHIMNEY FLUE ID CALCULATION**4 X 210 MW + 3 X 500 MW NTPC
Kahalgaon (Stag- I & II) - FGD

DOCUMENT NO.:

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ANNEXURE-I**FOR TENDER PURPOSE ONLY****4X210 MW NTPC KAHALGAON STAGE-I (FGD SYSTEM PACKAGE)**

CHIMNEY FLUE ID CALCULATION WITH BOROSILICATE LINER

Parameter	Units	Design Point (VWO)	Guarantee Point(210 MW)
Flue gas quantity per boiler	T/Hr	2792.5	2533.2
Temp. of flue gas at stack inlet	°C	81	75
Flue gas density at stack inlet	Kg/m ³	0.953	0.978
Volumetric flow per boiler	M ³ /s	813.95	719.50
Stack Height	M	180	180
Ambient air temp.	°C	45	27
Relative Humidity		60	60
Internal flue ID	M	7.15	7.15
Flue gas velocity at stack exit	m/sec	20.28	17.93

**TITLE:****CHIMNEY FLUE ID CALCULATION**4 X 210 MW + 3 X 500 MW NTPC
Kahalgaon (Stag- I & II) - FGD

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3 X 500 MW NTPC Kahalgaon (Stag- II) (FGD SYSTEM PACKAGE)**CHIMNEY FLUE ID CALCULATION WITH BOROSILICATE LINER**

Parameter	Units	Design Point (VWO)	Guarantee Point(500 MW)
Flue gas quantity per boiler	T/Hr	3217.8	3015.5
Temp. of flue gas at stack inlet	°C	62.6	59
Flue gas density at stack inlet	Kg/m ³	0.998	1.023
Volumetric flow per boiler	M ³ /s	895.62	818.81
Stack Height	M	150	150
Ambient air temp.	°C	45	27
Relative Humidity		60	60
Internal flue ID	M	7.6	7.6
Flue gas velocity at stack exit	m/sec	19.75	18.06

Clause no 5.0.0 of SPECIFICATION NO. PE-TS-999-600-C001, SECTION – D , SUB-SECTION – D1 amended as under:

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

- a) 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.
- 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.
- f) 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 in the proceeding sections. Where not so specified, the latest version of IS: 1200, Part-1 shall be applicable.

- 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) 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 rock so arrived shall be taken as soil.
- e) 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.