

NTPC LIMITED

**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM STPS
STG- I & II-FGD SYSTEM**

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-467- (571-13000-A)-A001 (REV-0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGINEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA**



TITLE:
TECHNICAL SPECIFICATION FOR
3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II - FGD SYSTEM
HVAC SYSTEM

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION

REV. 00

SHEET : 1 OF 2

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FGD SYSTEM
TECHNICAL SPECIFICATIONS FOR
HVAC SYSTEM**

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A)-A001**

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SECTION - I



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II
FGD SYSTEM
INTENT OF SPECIFICATION**

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**SECTION-I
SUB-SECTION-A
INTENT OF SPECIFICATION**



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II
FGD SYSTEM
INTENT OF SPECIFICATION**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

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1.0 INTENT OF SPECIFICATION

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, mandatory spares, Performance and guarantee testing / demonstration testing, O&M Services and handing over to BHEL's customer of **HVAC SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM STPS STG- I & II FGD SYSTEM , Peddapalli, district, Telangana, India.**
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **HVAC SYSTEM.**
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings/ specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL



**3 x 200MW + 3 x 500 MW NTPC
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and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the format attached with GCC (Annexure-II Deviation sheet (Cost of withdraw), otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section –D, however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please referred relevant clause of NIT.



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II
FGD SYSTEM
HVAC SYSTEM
PROJECT INFORMATION WITH WIND AND
SEISMIC DESIGN CRITERIA**

**SPECIFICATION No: PE-TS-467-(571-13000-
A)-A001**

SECTION : I

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SECTION: I

SUB-SECTION: B

**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN
CRITERIA**

**PROJECT INFORMATION –
RAMAGUNDAM-I& II (3X200MW + 2X500 MW)**

**LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(3)-9**

CLAUSE NO.	PROJECT INFORMATION		
1.00.00	<p>Background</p> <p>Ramagundam stage- I (3x200 MW) steam generators were designed for coals with GCV of 4300 kcal/kg while presently the units are fired with coal having GCV in the range of 3500-3800 kcal/kg.</p>		
1.01.00	<p>Location and Approach</p> <p>NTPC Ramagundam (RSTPS) is a pit-head thermal power station based on the coal supplied from the nearby Singareni Mines of M/s. SCCL and water from Pochampad Dam. The station is located in the Peddapalli district of the Indian state of Telangana. about 60 kms from Karimnagar town and 100 kms from Warangal. Ramagundam Railway station is on the Delhi - Chennai main line. Ramagundam is well connected to Hyderabad by Rajiv Rahadari state highway.</p> <p>The aerial distance from Ramagundam to Hyderabad is 178 km while the road distance between Ramagundam to Hyderabad is 209 km and by train it is 224 Km. Nearest commercial airport is Rajiv Gandhi International Airport, Hyderabad at about 250 km.</p> <p>Vicinity plan of the proposed project is placed at Annexure –I.</p>		
1.02.00	Not Used		
1.03.00	<p>Unit Capacity</p> <p>The units are originally designed for 200 MW which is being uprated for unit TMCR (Turbine through separate R&M package) rating of 210 MW. This applies to all the three units. The BMCR shall remain the same and is considered adequate for the uprated steam turbine.</p>		
1.04.00	<p>Equipment cooling water</p> <p>The cooling water system for equipment/systems is taken from existing equipment cooling water (ECW) sources. Any requirement for equipment cooling shall be from the existing ECW system only. Water for ash disposal requirements, if any, shall also be taken from existing nearby ash water lines.</p>		
1.05.00	<p>Coal Quality Parameters / Fuel Oil Characteristics</p> <p>Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details:</p> <p>(i) The Coal quality parameters and Fuel Oil characteristics are indicated in Table-1 & Table-2 respectively below.</p> <p>(ii) Process water: Process water quality is CW Blowdown based on the COC indicated in Table-4.</p> <p>(iii) Clarified water:</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p>PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p>PAGE 1 OF 32</p>

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	<p>Clarified water quality is indicated in Table-4.</p> <p>(iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-5.</p> <p>1.06.00 Steam Generator and ESP data: refer Table-6.</p> <p>1.07.00 Drawings are enclosed as per Table-7 for initial overview to the Bidder.</p> <p>2.00.00 NOT USED</p> <p>3.00.00 Capacity</p> <p style="padding-left: 40px;">Stage-I 3 x 200 MW</p> <p style="padding-left: 40px;">Stage-II 3 x 500 MW</p> <p>4.00.00 Metrological Data</p> <p>The metrological data from nearest observatory is placed at Annexure-II.</p> <p>5.00.00 Criteria for Earthquake Resistant Design of Structures and Equipment</p> <p>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.</p> <p>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.</p> <p>Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.</p> <p>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).</p>		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p style="text-align: center;">PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p style="text-align: center;">PAGE 2 OF 32</p>

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	<p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table border="0" data-bbox="407 386 1284 611"> <tr> <td>a)</td> <td>Steel structures</td> <td>:</td> <td>2%</td> </tr> <tr> <td>b)</td> <td></td> <td>:</td> <td>5%</td> </tr> <tr> <td></td> <td>Reinforced Concrete structures</td> <td></td> <td></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> <p>Method of Analysis</p> <p>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).</p> <p>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).</p> <p>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.</p> <p>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.</p> <p>Design/Detailing for Ductility for Structures</p> <p>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.</p>			a)	Steel structures	:	2%	b)		:	5%		Reinforced Concrete structures			c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%
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<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p align="center">PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p align="center">PAGE 3 OF 32</p>																				

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	<p style="text-align: right;"><u>APPENDIX – I</u></p> <p><u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <p>The various site specific seismic parameters for the project site shall be as follows:</p> <ol style="list-style-type: none"> 1) Peak ground horizontal acceleration (MCE) : 0.28 g 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 <ol style="list-style-type: none"> a) for special moment resisting steel frames designed and detailed as per IS:800 : 0.082 b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.062 c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.049 d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.163 e) For Liquid retaining tanks : 0.098 f) for Steel chimney, Absorber tower, Vessels : 0.123 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) : 0.082 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 : 0.163 <p>Note: g = Acceleration due to gravity</p> <p>The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.</p>		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p style="text-align: center;">PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p style="text-align: center;">PAGE 4 OF 32</p>

CLAUSE NO.	PROJECT INFORMATION		
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CLAUSE NO.

PROJECT INFORMATION

ANNEXURE-A

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0	1.000	1.000	1.000
0.03	1.000	1.842	1.450
0.04	1.355	2.032	1.600
0.05	1.716	2.223	1.750
0.06	2.081	2.413	1.900
0.07	2.449	2.604	2.050
0.08	2.820	2.794	2.200
0.09	3.194	2.985	2.350
0.10	3.570	3.175	2.500
0.105	3.759	3.175	2.500
0.106	3.760	3.175	2.500
0.11	3.760	3.175	2.500
0.115	3.760	3.175	2.500
0.12	3.760	3.175	2.500
0.125	3.760	3.175	2.500
0.13	3.760	3.175	2.500
0.135	3.760	3.175	2.500
0.14	3.760	3.175	2.500
0.145	3.760	3.175	2.500
0.15	3.760	3.175	2.500
0.20	3.760	3.175	2.500
0.25	3.760	3.175	2.500
0.27	3.760	3.175	2.500
0.30	3.760	3.175	2.500
0.32	3.760	3.175	2.500
0.35	3.760	3.175	2.500
0.372	3.760	3.175	2.500
0.40	3.500	3.175	2.500
0.402	3.483	3.159	2.488
0.405	3.457	3.136	2.469
0.41	3.415	3.098	2.439
0.425	3.294	2.988	2.353
0.45	3.111	2.822	2.222
0.50	2.800	2.540	2.000

LOT-3 PROJECTS
 FLUE GAS DESULPHURISATION (FGD)
 SYSTEM PACKAGE

TECHNICAL SPECIFICATION
 SECTION-VI
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PART-A
 SUB SECTION-IIA5
 PROJECT
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CLAUSE NO.	PROJECT INFORMATION			
	ANNEXURE-A			
	<u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u> (In units of 'g')			
	Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
		2%	3%	5%
	0.55	2.545	2.309	1.818
	0.60	2.333	2.117	1.667
	0.65	2.154	1.954	1.538
	0.70	2.000	1.814	1.429
	0.75	1.867	1.693	1.333
	0.80	1.750	1.588	1.250
	0.85	1.647	1.494	1.176
	0.9	1.556	1.411	1.111
	0.95	1.474	1.337	1.053
	1.0	1.400	1.270	1.000
	1.05	1.333	1.210	0.952
	1.10	1.273	1.155	0.909
	1.15	1.217	1.104	0.870
	1.20	1.167	1.058	0.833
	1.25	1.120	1.016	0.800
	1.30	1.077	0.977	0.769
	1.35	1.037	0.941	0.741
	1.40	1.000	0.907	0.714
	1.45	0.966	0.876	0.690
	1.50	0.933	0.847	0.667
	1.55	0.903	0.819	0.645
	1.60	0.875	0.794	0.625
	1.65	0.848	0.770	0.606
	1.70	0.824	0.747	0.588
	1.75	0.800	0.726	0.571
	1.80	0.778	0.706	0.556
	1.85	0.757	0.686	0.541
	1.90	0.737	0.668	0.526
	1.95	0.718	0.651	0.513
	2.0	0.700	0.635	0.500
	2.05	0.683	0.620	0.488
	2.10	0.667	0.605	0.476
	2.15	0.651	0.591	0.465
	2.20	0.636	0.577	0.455
	2.25	0.622	0.564	0.444
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9	PART-A SUB SECTION-IIA5 PROJECT INFORMATION	PAGE 7 OF 32	

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ANNEXURE-A

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.30	0.609	0.552	0.435
2.35	0.596	0.540	0.426
2.40	0.583	0.529	0.417
2.45	0.571	0.518	0.408
2.50	0.560	0.508	0.400
2.55	0.549	0.498	0.392
2.60	0.538	0.488	0.385
2.65	0.528	0.479	0.377
2.70	0.519	0.470	0.370
2.74	0.511	0.464	0.365
2.80	0.500	0.454	0.357
2.85	0.491	0.446	0.351
2.88	0.486	0.441	0.347
2.90	0.483	0.438	0.345
2.95	0.475	0.431	0.339
3.0	0.467	0.423	0.333
3.05	0.459	0.416	0.328
3.10	0.452	0.410	0.323
3.15	0.444	0.403	0.317
3.20	0.438	0.397	0.313
3.25	0.431	0.391	0.308
3.30	0.424	0.385	0.303
3.35	0.418	0.379	0.299
3.40	0.412	0.374	0.294
3.45	0.406	0.368	0.290
3.50	0.400	0.363	0.286

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9	PART-A SUB SECTION-IIA5 PROJECT INFORMATION	PAGE 8 OF 32
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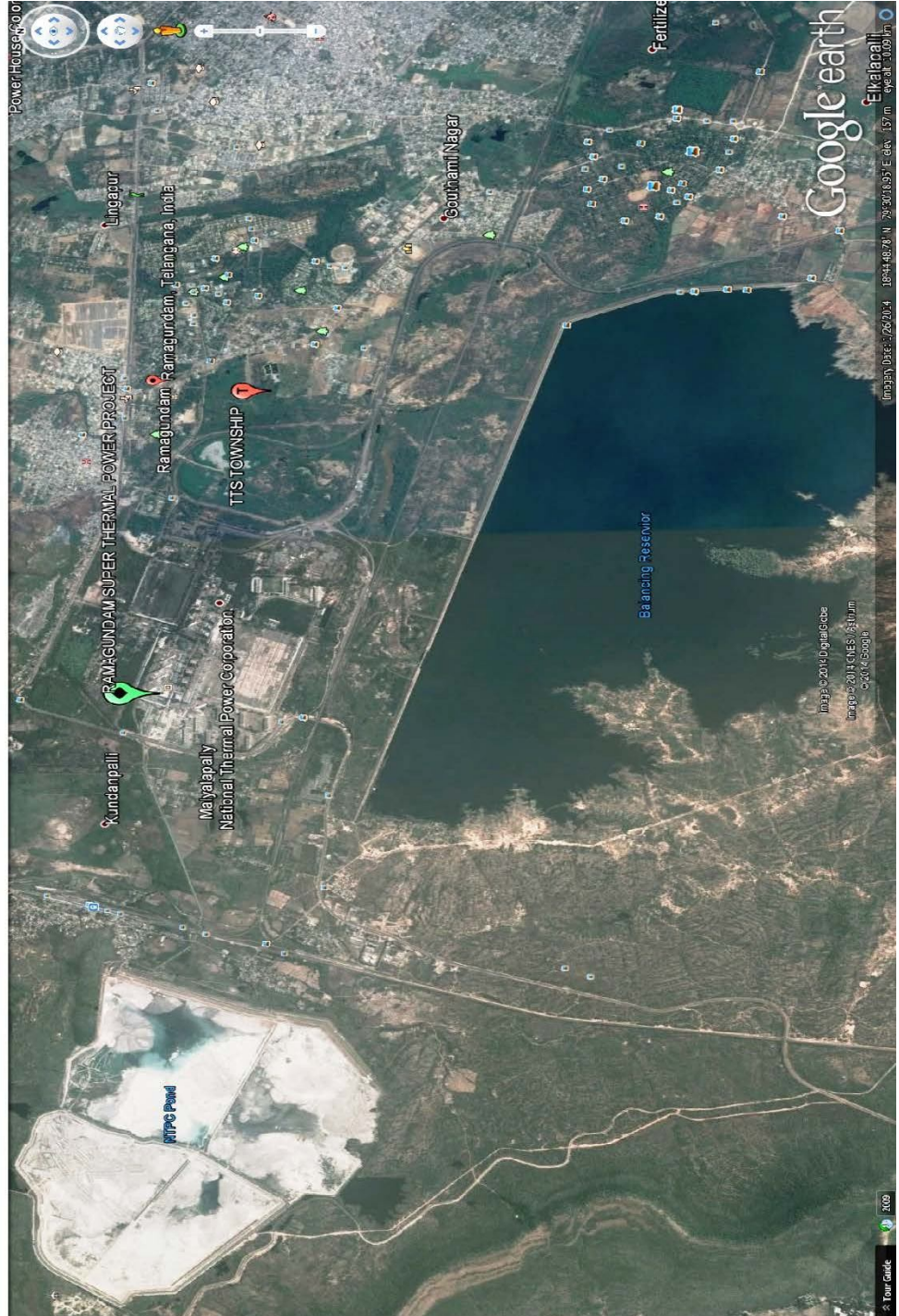
CLAUSE NO.	PROJECT INFORMATION														
6.00.00	<p>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures shall be designed for wind forces in accordance with IS: 875 (Part-3) and as specified in this document. See Annexure – B for site specific information.</p> <p>Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table data-bbox="391 1260 1448 1575"> <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.													
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p align="center">PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p align="center">PAGE 9 OF 32</p>												

CLAUSE NO.

PROJECT INFORMATION

ANNEXURE-I
VICINITY MAP

SATELLITE MAP OF NTPC-RAMAGUNDAM



LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
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PART-A
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CLAUSE NO.

PROJECT INFORMATION

ANNEXURE-II

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्थान : रामगुंडम STATION : Ramgundam देशान्तर LONG. 79°26' अक्षांश LAT. 18°46' सागरी सतह से ऊंचाई HEIGHT ABOVE M.S.L. 156 METRES वर्षों पर आर्वादि BASED ON OBSERVATIONS 1971-2000

मास MONTH	वायु तापमान AIR TEMPERATURE						चाप EXTREMES		आर्द्रता HUMIDITY		समुद्र सतह से ऊंचाई CLOUD AMOUNTS		वर्षा RAIN FALL								
	सूक्ष्म शून्य ताप से अधिक ताप		सूक्ष्म शून्य ताप से कम ताप		उच्चतम ताप	निम्नतम ताप	दिनांक और वर्ष	दिनांक और वर्ष	सापेक्ष आर्द्रता	वाष्प दाब	समस्त बादल	समुद्र सतह से ऊंचाई	मासिक वर्षा	वर्षों के दिनों की संख्या	सर्वाधिक ताप से अधिक दिनों की संख्या	सर्वाधिक शुष्कता से अधिक दिनों की संख्या	24 घण्टों की अवधि में अधिकतम वर्षा	दिनांक और वर्ष	मासिक वर्षा		
	DRY BULB °C	WET BULB °C	DAILY MAX °C	DAILY MIN °C	HIGHEST °C	LOWEST °C	DATE AND YEAR	DATE AND YEAR	RELATIVE HUMIDITY %	VAPOUR PRESSURE hPa	ALL CLOUDS	LOW CLOUDS	mm	NO. OF RAINY DAYS	mm	mm	mm	DATE YEAR	mm		
जनवरी JAN	19.9	17.0	30.7	15.6	35.3	28	8.0	4	1991	74	17.4	1.6	0.7	11.5	0.7	53.0	0.0	47.6	20	2.6	
फरवरी FEB	22.9	18.8	33.5	18.5	39.4	29	8.4	22	1980	65	18.6	1.8	0.9	9.7	0.7	77.2	0.0	56.8	6	3.3	
मार्च MAR	26.9	21.0	37.5	21.8	43.0	29	13.0	11	1979	57	20.2	1.3	0.5	9.2	0.7	71.6	0.0	40.4	12	3.5	
अप्रैल APR	30.5	23.7	40.5	25.7	45.6	30	15.4	20	1971	55	23.8	1.8	0.5	13.7	1.1	97.7	0.0	62.0	24	4.6	
मई MAY	38.2	24.1	42.1	28.3	47.3	24	20.4	1	1977	49	23.9	2.5	0.7	34.7	2.4	142.2	0.0	111.2	1	4.5	
जून JUN	39.7	25.2	43.7	33.4	49.2	19	24.4	3	1973	65	26.6	5.2	1.8	180.1	8.7	373.3	0.0	158.8	15	4.9	
जुलाई JUL	39.8	25.8	43.8	33.4	47.2	8	19.4	14	1953	79	28.5	6.3	2.4	328.2	14.5	727.2	104.3	131.6	17	3.6	
अगस्त AUG	30.5	25.7	36.6	22.2	41.0	6	18.8	1973	68	29.2	6.3	2.7	285.8	13.1	638.9	46.4	161.9	13	2.9		
सितंबर SEP	26.7	24.4	34.8	22.6	37.9	4	19.8	31	1965	82	28.7	6.3	2.6	166.9	8.2	430.4	13.1	145.3	20	2.0	
अक्टूबर OCT	23.2	20.6	31.1	21.1	36.6	28	17.8	30	1972	80	29.2	4.9	1.9	102.5	4.7	539.6	0.0	135.8	24	1.6	
नवंबर NOV	23.1	19.7	31.5	18.0	36.6	6	9.0	30	1957	76	26.0	3.0	1.1	24.0	1.7	118.0	0.0	70.2	5	1.5	
दिसंबर DEC	19.6	16.6	30.0	14.4	35.5	14	7.5	24	1984	72	16.8	1.5	0.3	6.5	0.6	109.4	0.0	101.2	2	1.7	
वार्षिक औसत ANNUAL TOTAL OR MEAN	26.0	21.8	34.5	22.1	47.3	24	7.5	24	1984	69	23.3	3.2	1.2	1172.8	57.0	1747.1	565.2	161.9	13	3.0	
वार्षिक संख्या NUMBER OF YEARS	30	30	30	30	30	53	53	30	1984	49	22.3	3.6	1.5	30	30	50	50	50	8	1986	24

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LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-0011-109 (3)-9

PART-A
SUB SECTION-IIA5
PROJECT
INFORMATION

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CLAUSE NO.	PROJECT INFORMATION
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TABLE-3 (NOT USED)

TABLE-4

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l
1	Calcium	CaCO ₃	104
2	Magnesium	CaCO ₃	88
3	Sodium	CaCO ₃	59
4	Potassium	CaCO ₃	4
	Total cations	CaCO ₃	255
5	HCO ₃	CaCO ₃	155
6	P- Alkalinity	CaCO ₃	0
7	Chloride	CaCO ₃	54
8	Sulphate	CaCO ₃	46
	Total Anions	CaCO ₃	255
9	Silica, Reactive	Si	5
10	Iron (Total)	Fe	0.5
11	pH	-	7.0-7.8
12	Turbidity	NTU	10
13	Total dissolved solids		250-300
14	Temperature	Deg C	20-35

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9	PART-A SUB SECTION-IIA5 PROJECT INFORMATION	PAGE 28 OF 32
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CLAUSE NO.	PROJECT INFORMATION																				
	<p style="text-align: center;">TABLE-5</p> <p style="text-align: center;">ANALYSIS OF DM WATER</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th data-bbox="479 390 735 422">Sl.No.</th> <th data-bbox="558 390 735 422">Characteristics</th> <th data-bbox="989 390 1057 422">Value</th> </tr> </thead> <tbody> <tr> <td data-bbox="479 464 500 495">1.</td> <td data-bbox="558 464 695 495">Silica (Max.)</td> <td data-bbox="989 464 1182 495">0.02 ppm as Sio2</td> </tr> <tr> <td data-bbox="479 533 500 564">2.</td> <td data-bbox="558 533 672 564">Iron as Fe</td> <td data-bbox="989 533 1024 564">Nil</td> </tr> <tr> <td data-bbox="479 602 500 634">3.</td> <td data-bbox="558 602 721 634">Total hardness</td> <td data-bbox="989 602 1024 634">Nil</td> </tr> <tr> <td data-bbox="479 672 500 703">4.</td> <td data-bbox="558 672 656 703">pH value</td> <td data-bbox="989 672 1073 703">6.8 -7.2</td> </tr> <tr> <td data-bbox="479 741 500 772">5.</td> <td data-bbox="558 741 695 772">Conductivity</td> <td data-bbox="989 741 1349 814">Not more than 0.1micro mho/cm excluding the effects of free CO2</td> </tr> </tbody> </table> <hr style="width: 50%; margin-left: auto; margin-right: auto;"/>			Sl.No.	Characteristics	Value	1.	Silica (Max.)	0.02 ppm as Sio2	2.	Iron as Fe	Nil	3.	Total hardness	Nil	4.	pH value	6.8 -7.2	5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO2
Sl.No.	Characteristics	Value																			
1.	Silica (Max.)	0.02 ppm as Sio2																			
2.	Iron as Fe	Nil																			
3.	Total hardness	Nil																			
4.	pH value	6.8 -7.2																			
5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO2																			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9	PART-A SUB SECTION-IIA5 PROJECT INFORMATION	PAGE 29 OF 32																		

CLAUSE NO.	PROJECT INFORMATION		
TABLE-6			
STEAM GENERATOR DATA Stage-I & Stage II (Per Unit basis)			
1.	Location	Outdoor	
2.	Operation	Base load	
3.	Type	Pulverised coal fired	
4.	Maximum Continuous Rating	Stage-I 670 Tonns/hr. Stage-II 1725 Tonns/hr.	
5.	Steam pressure at SH outlet	Stage-I 157 Kg/cm ² (a) Stage-II 178 Kg/cm ² (a)	
6.	Steam temperature at SH outlet	Stage-I 540 Deg C Stage-II 540 Deg C	
7.	Oil for start up and flame stabilisation	LDO/HFO	
8.	Fuel oil system sizing	7.5% of Boiler MCR for LDO & 30% of Boiler MCR for HFO	
9.	Pulverised coal size	Minimum 70% through 200 Mesh and 99% thru 50 mesh	
10.	Type of pulveriser	Vertical spindle mills	
11.	Type of oil burners	Air atomised for LDO Steam atomised for HFO	
12.	No. of air heaters	Stage I Two (2) Tri-sector APH Stage II Four number (4) Bi-sector APH	
13.	No. of ID Fans	Stage-I Two (both working) Stage-II Two (Both working)	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9	PART-A SUB SECTION-IIA5 PROJECT INFORMATION	PAGE 30 OF 32

CLAUSE NO.	PROJECT INFORMATION											
	<p data-bbox="407 264 1040 296">ESP DATA Stage I & Stage II (Per Unit basis)</p> <ol data-bbox="451 369 1138 611" style="list-style-type: none"> 1. Location: Downstream side of Air preheaters 2. Operation: Base load 3. Type: Rigid Discharge frame 4. Rapping: Intermittent <p data-bbox="760 814 894 846" style="text-align: center;">TABLE-7</p> <p data-bbox="407 884 1166 915">List of Drawings/Details placed below in this sub section:</p> <table border="1" data-bbox="407 989 1430 1182"> <thead> <tr> <th data-bbox="407 989 516 1052">Sl.No.</th> <th data-bbox="516 989 894 1052">Drawing Description</th> <th data-bbox="894 989 1430 1052">Drawing No.</th> </tr> </thead> <tbody> <tr> <td data-bbox="407 1052 516 1115">1.</td> <td data-bbox="516 1052 894 1115">General Layout Plan</td> <td data-bbox="894 1052 1430 1115">Enclosed</td> </tr> <tr> <td data-bbox="407 1115 516 1182">2.</td> <td data-bbox="516 1115 894 1182">Chimney foundation</td> <td data-bbox="894 1115 1430 1182">Refer details below</td> </tr> </tbody> </table>			Sl.No.	Drawing Description	Drawing No.	1.	General Layout Plan	Enclosed	2.	Chimney foundation	Refer details below
Sl.No.	Drawing Description	Drawing No.										
1.	General Layout Plan	Enclosed										
2.	Chimney foundation	Refer details below										
<p data-bbox="269 1854 643 1923" style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p data-bbox="703 1860 1016 1934" style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (3)-9</p>	<p data-bbox="1078 1843 1252 1934" style="text-align: center;">PART-A SUB SECTION-IIA5 PROJECT INFORMATION</p>	<p data-bbox="1284 1875 1433 1896" style="text-align: center;">PAGE 31 OF 32</p>									

APGENCO
62.5 MW
MAIN PLANT

50M

APGENCO
SWITCH YARD

APGENCO
PLANT RLY.
TRACK

PUBLIC ROAD

2200N

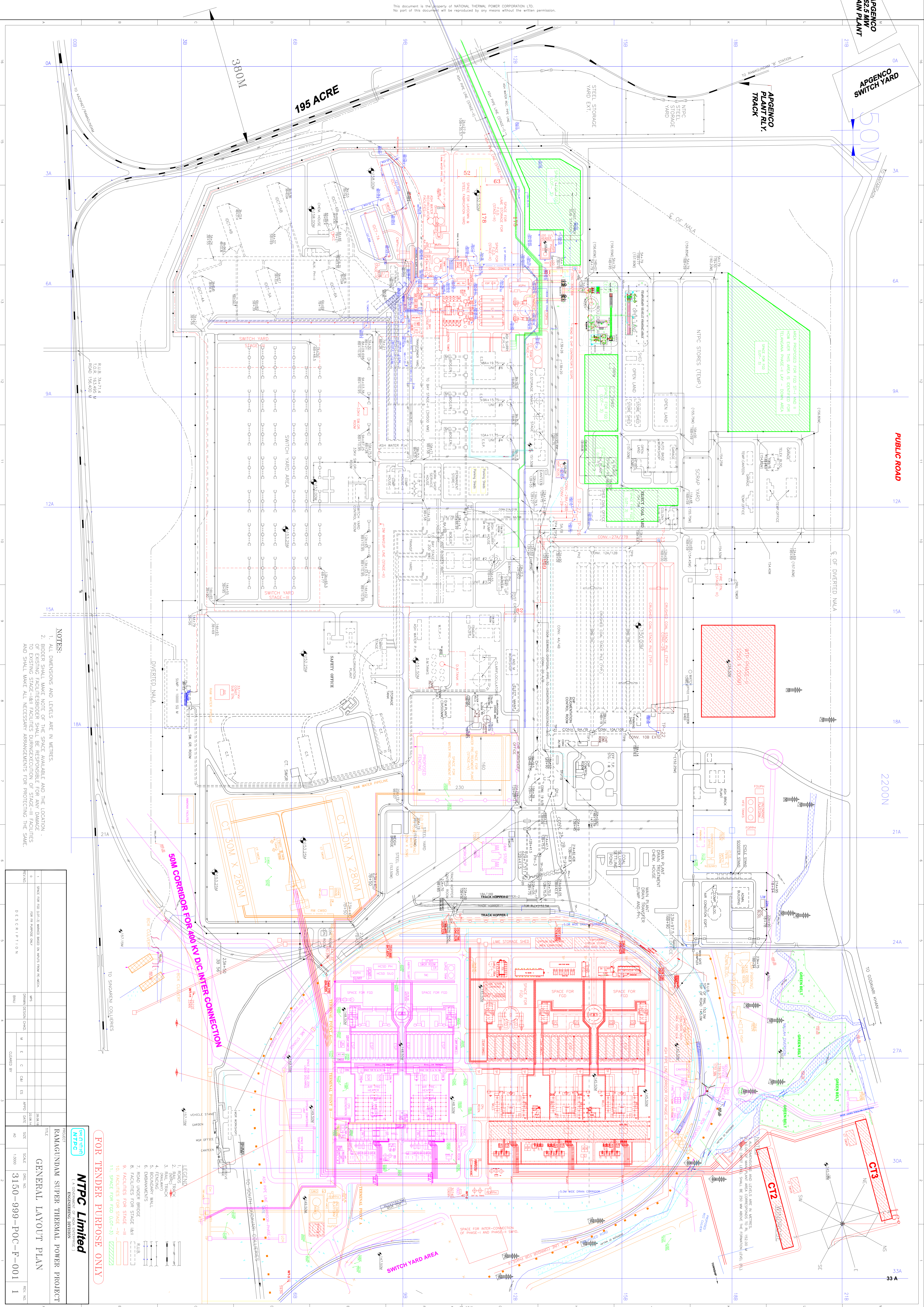
300A

33A

195 ACRE

380M

50M CORRIDOR FOR 400 KV DC INTER CONNECTION



- NOTES:
1. ALL DIMENSIONS AND LEVELS ARE IN METRES.
 2. BIDDER SHALL MAKE NOTE OF THE SPACE AVAILABLE AND THE LOCATION OF EXISTING FACILITIES. BIDDER SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING STAGE-III FACILITIES DURING EXECUTION OF STAGE-III FACILITIES AND SHALL MAKE ALL NECESSARY ARRANGEMENTS FOR PROTECTING THE SAME.

REV	DESCRIPTION	DATE	BY	CHECKED BY
1	ISSUED FOR TENDER	15/03/2010	BRU	ES
2	FOR TENDER PURPOSE ONLY	15/03/2010	BRU	ES

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
PROJECT: RAMAGUNDAM SUPER THERMAL POWER PROJECT
TITLE: GENERAL LAYOUT PLAN
SCALE: 1:1000
DOC. NO.: 3150-999-POC-F-001
REV. NO.: 1

FOR TENDER PURPOSE ONLY



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II
FGD SYSTEM
HVAC SYSTEM
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

Sub Section : C

REV. 00

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATIONS



**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM
STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-467-(571-13000-
A)-A001**

SECTION : I

SUB-SECTION : C 1

REV. 00

SHEET 1 OF 16

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT



**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM
STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
SPECIFIC TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

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SHEET 2 OF 16

1. FUNCTION

The purpose of the system is to provide HVAC system for different areas of 3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM STPS STG- I & II FGD SYSTEM under the scope of this tender.

2. SYSTEM DESCRIPTION

2.1 AC SYSTEM

AC –Plant

AC plant, in FGD control room building is provided to cater the air conditioning requirements of the control room for FGD control room building.

The air conditioning plant shall comprise of 4x50% Air cooled condensing units (D-X type) type air conditioners with AHUs of suitable capacity with 4x50% redundancy and other accessories as per the system/specification requirement. These AHU shall be located in AHU rooms located adjacent to air-conditioned areas. The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded Aluminium grilles / diffusers with volume control dampers and supporting frames.

Controls for the AC & Ventilation (common) shall be DCS based.

For balance offsite areas, SPLIT TYPE AIR CONDITIONERS shall be provided as enumerated below:-

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of for auxiliary plant. Local isolator / MCB shall be provided with split units.

Hand operated remote and other accessories as specified. Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners. Each split unit shall also be provided with suitable rating stabiliser.

Single phase electrical feeders of following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirements.

Capacity of Split AC	Single phase supply feeder
1.5 TR	32 Amp
2 TR	

2.2 VENTILATION SYSTEM

2.2.1 The Ventilation System is provided within the FGD control room building by UAF as detailed out in technical specification section C-2 shall be provided.

2.2.2 Battery and Battery charger room and other Auxiliary Buildings.

Please refer to relevant clauses of customer technical specifications section C-2A for other detail of system description. For ventilation of battery rooms and any other area having fume generation, flame proof motor shall be used.



**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM
STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
SPECIFIC TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C 1

REV. 00

SHEET 3 OF 16

3. DESIGN CRITERIA

3.1 The outside design conditions considered are as follows: -

	Summer	Monsoon	Winter
DBT (°C)	45	35.8	12.8
WBT (°C)	27.5	28.3	8.9

3.2 AC system: -

Design criteria shall be as per NTPC specification, section-VI, Part-A, Sub Section-V, clause number 6.01.00 enclosed under-sub section C2A, section -1.

3.3 Ventilation system: -

Design criteria shall be as per NTPC specification, section-VI, Part-A, Sub Section-V, clause number 6.03.00 enclosed under-sub section C2A, section -1.

4. SYSTEM CAPACITY AND CONFIGURATION:

a) For AC Plant: -

4x50 % (minimum 65 TR Actual capacity) DX- type air cooled condensing unit (2 working + 2 Standby) shall be provided.

b) For Ventilation system: -

2X 90000 (Both working) CMH capacity UAF shall be provided.

5. LAYOUT CONSIDERATIONS:

a) AC PLANT

- I. Air cooled DX-type condensing units for AC Plant shall be located at the roof of FGD control room building.
- II. The AHUs for these DX units will be located inside AHU room located adjacent to AC area.
- III. 1 T Capacity Chain pulley block with/without Monorail arrangement shall be provided for the AHU for maintenance purpose.

b) Ventilation system



**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM
STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
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SUB-SECTION : C 1

REV. 00

SHEET 4 OF 16

- I. UAF shall be placed at the roof of FGD control room building.
- II. UAF shall be placed in open, exposed to ambient conditions and no masonry room shall be provided.
- III. The exhaust air from battery room shall be taken out through MS duct having epoxy coating and the air shall be released above roof of the building.

For other design parameters refer to section C2-A, customer specifications

6. EQUIPMENT DETAILS:

6.1 AC EQUIPMENT DETAILS

6.1.1 Air cooled condensing unit

Refer to relevant clauses of section C2-A, customer specifications

6.1.2 AIR HANDLING UNIT (DOUBLE SKIN TYPE)

- a) Motors shall be installed inside the AHU.
- b) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided per customer approved PID
- c) Drain piping from the AHUs up to nearest drain point.
- d) Serrated rubber pads for vibration isolation
- e) For other details please refer to relevant clauses of section C2-A, customer specifications.

6.1.3 STRIP HEATER PACKAGE AND HUMIDIFICATION PACKAGE

- a) One set of electrical strip heater package of suitable capacity shall be provided in supply air duct. Heater package shall be connected with thermostat / Humidistat which will be provided in return air path inside AHU Room / Package AC Room.

Temp gauge, temp element shall also be provided and the same shall be hooked with DCS system. RH and temp sensor shall be provided and the same shall be hooked with DCS system.

- b) One No. pan humidifier comprising heater, humidistat, water tank, low level switch over flow, draining, make up connection, float valves etc for each AHU Room.
- c) For other details please refer to relevant clause of section C2-A, customer specifications

6.1.4 Insulation

Please refer to relevant clause of section C2-A, customer specifications.

6.2 VENTILATION EQUIPMENT DETAILS

6.2.1 UAF

Each UAF shall comprise of:

- a) Efficiency of centrifugal fan and pump shall not be less than 70%.



**3 x 200MW + 3 x 500 MW NTPC RAMAGUNDAM
STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
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- b) Please refer to relevant clauses of Customer technical specification section C-2A for UAF construction.

6.2.2 CENTRIFUGAL FLOW FAN UNITS

- a) Please refer to relevant clauses of Customer technical specification section C-2A for centrifugal fan.

6.2.3 WALL MOUNTED AXIAL FLOW FAN

- a) Adjustable damper, vibration isolators, nuts and bolts, back draft dampers etc. Shall be provided.
b) These fans shall cater to the areas as indicated in the fan schedule of ventilation system
c) Please refer to relevant clauses of Customer technical specification section C-2A for detail construction of axial flow fan.

6.2.4 ROOF EXTRACTOR UNIT

- a) Each roof extractor unit shall be complete with foundation bolts including screen at bottom.
b) Please refer to relevant clauses of Customer technical specification section C-2A for detail construction of RE Unit.

6.2.5 INSULATION

- a) Thermal insulation shall be provided for the duct exposed to sun / rain only.
b) Please also refer to other relevant clauses of Customer technical specification section C-2A for detail construction of insulation.

6.2.6 WATER PUMP SETS

Each circulating water pump set for UAF shall comprise of the following

- a) Pump (as per the specification) of adequate capacity to match the system requirement UAF spraying arrangement.
b) One no. adequately sized TEFC sq. cage induction motor suitable for 415V, 3 phase, 50 Hz AC supply.
c) One no. Pot type strainer at inlet complete with screen, drain arrangement etc.
d) 150 mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.
e) One no. non-return (check) valve at discharge side of pump set.
f) One set of base plate, coupling, coupling guard, anti-vibration mountings, foundation bolts etc.
g) Rain protection canopy for the pumps and motors, if located at outdoor shall be provided.
h) Please also refer to other relevant clauses of Customer technical specification section C-2A for detail construction of water pump.

6.3 COMMON FOR BOTH AC AND VENTILATION SYSTEM

6.3.1 SHEET METAL WORK



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- a) Air distribution would be done through ducting system, grilles and diffusers. All ducting shall be designed on equal friction method and fabricated as per IS: 655
- b) Supply air diffusers / grilles (Frame and Louvers of Diffuser/Grilles shall be of extruded aluminium of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume control Damper.
- c) For other details please refer to relevant clauses of section C2-A, customer specifications

6.3.2 FIRE DAMPERS

- a) Motorized fire damper shall be installed at supply and return air duct at suitable locations where duct pass through wall & floors for ease of isolation, maintenance and as well as for emergency operation. Fire damper in the supply and return air duct shall close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Necessary arrangement shall be incorporated in the duct for providing duct mounted multi- sensor detectors in the return air duct for all air conditioned areas. Also respective Air Handling Units, Air washers/UAFs shall trip on receiving fire signal from fire protection system.
- b) For fire damper refer to relevant clauses of section C2-A, customer specifications.

6.3.3 PIPING VALVES ETC

- a) Refer to relevant clauses of section C2-A, customer specifications

7. ELECTRICAL ITEMS:

Refer to relevant clauses of section C2-A, customer specifications and section C-3, electrical portion of specifications.

8. CONTROL PHILOSOPHY

A DCS based control system shall be provided for AC & Ventilation system. The DCS based control system shall cover the followings.

- AC system for FGD control room building.
- UAF unit for FGD control room building.
- Refer to clause of section, C-4 of specification.

8.1 SAFETY CONTROLS

All necessary measuring – control instruments & control system shall be provided. With following compressor & evaporator interlock in the control panel of the condensing unit.

- a) High discharge pressure cut-out (HP) as applicable
- b) Low suction pressure cut out (LP) as applicable
- c) Oil pressure cut-out (OP) as applicable
- d) Anti-freeze thermostat (AFT) as applicable
- e) Any other essential safety control as per the OEM



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8.2 OPERATING CONTROL

All operating control as necessary shall be provided. However following minimum control shall be provided:-

- a) Automatic capacity control system as applicable.
- b) Automatic unloaded starting device
- c) Operating Thermostat
- d) Unloading solenoid valves (if applicable)
- e) 3 way flow control valve at the AHU's (if applicable)
- f) Operation / Sequence Interlock of the Air conditioning system shall be as under:
 - I. Condenser fan is started.
 - II. The Air Handling Unit is started.
 - III. Chilling unit is started

8.3 INTERFACE WITH DCS

Following hardwired signals shall be provided in the DCS for monitoring purpose for AC system

- a) Temperature & Humidity.
- b) AC Plant On / Off Status.
- c) Pump Run / Trip.
- d) AHU Run / Trip.
- e) General AC Plant Warning.

8.4 INDICATIONS PROVIDED FOR UAF IN LOCAL CONTROL PANEL

FAN RUNNING

FAN STOP

PUMP - 1 RUNNING

PUMP - 1 STOP

FAN MOTOR OVERLOAD.

PUMP - 1 MOTOR OVERLOAD.

The water sump of each Unitary Air Filtration Units shall be provided with a level transmitter which will initiate an alarm and will trip the pump sets, in case the water level falls below the predetermined level.

9. SPECIFIC REQUIREMENT

- Efficiency of centrifugal fan and pump shall not be less than 70%.
- All ventilation system shall operate on 100% fresh air.
- UAF shall have 60% saturation efficiency(minimum).
- Ventilation ducts shall be provided with motorized type fire dampers at the supply duct in electrical area like MCC / Switch gear room/ cable spreader room, as well as Electrical areas which will close in case of fire.



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- The fire damper shall close the air flow inside the duct on receiving fire alarm signal from FPS. Also respective fan shall trip once the fire damper is closed.
- Air Velocity through different system equipment should be maintained as the specification. However higher velocity of air shall be selected in case of layout constraint to run the ducting.
- Roof Exhausters and wall mounted Exhaust Fan motors shall be designed for a minimum 55 degree C ambient while the supply air fan motors shall be designed for a min.50 degree C.
- All fans shall be selected with non-overloading characteristics as far as practicable and the respective drive motor shall have a rating more than the limit load of the fan or at least 20% higher than the brake horse power, which is higher.
- Design margin shall be maintained as follows:
 - For Pump a) Head-10% b) Flow-10%
- RE / wall mounted fans shall be selected so as to have motor rating and wall / slab opening as under. Feeder suitable for following ratings only shall be provided by BHEL.

1.	Roof extractor units with 15 mmwc static pressure.		
	Capacity	Motor rating	Roof / Slab opening
a.	40,000 CMH	5.5 KW	1320mm
b.	20,000 CMH	2.2 KW	1140mm
2	Axial flow supply fans with 30 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	2.2 KW	800mmx800mm
b.	7,500 CMH	1.5 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	500mmx500mm
3	Axial flow supply fans with 20 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	1.5 KW	800mmx800mm
b.	7,500 CMH	1.1 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm



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d.	4,000 CMH	0.75 KW	600mmx600mm
4	Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	2.2 KW	900mmx900mm
b.	10,000 CMH	1.5 KW	800mmx800mm
c.	7,500 CMH	1.1 KW	700mmx700mm
d.	4,000 CMH	0.75 KW	600mmx600mm
e.	2,000 CMH	0.55 KW	500mmx500mm
5	Axial flow exhaust fans with 10 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	1.1 KW	900mmx900mm
b.	10,000 CMH	0.75 KW	800mmx800mm
c.	7,500 CMH	0.55 KW	700mmx700mm
d.	6,000 CMH	0.55 KW	600mmx600mm
e.	4,000 CMH	0.55 KW	600mmx600mm
f.	2,000 CMH	0.37 KW	500mmx500mm
6	Exhaust fan (propeller type) with 5 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	1000 CMH	100 W	330 mm circular



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10. MATERIALS OF CONSTRUCTION

10.1 CENTRIFUGAL FAN

- Fan Casing (side plates & stiffeners): Mild Steel Sheets with spray galvanized to IS: 2062 Gr.B / IS: 1079 /Eq. The minimum thickness of casing shall be 3.00 mm.
- Impeller hub: Mild Steel
- Impeller back plate blade & shroud: Mild Steel to IS: 2062 Gr.B.
- Shaft: EN - 8 or eqv.
- Shaft sleeve: EN - 8 or eqv.
- Flexible connection at outlet/inlet: Fire resistant type plastic impregnated canvas with M.S. flange and cleats (3 mm thick).
- V Belt (matched sets): ISI marked (Reinforced rubber section to (IS: 4776)
- Bolts & nuts: Galvanized / MS (Epoxy painted).
- Vibration isolating cushy foot mountings, foundation bolts and nuts etc.
- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of centrifugal fan.

10.2 AXIAL FAN

- Hub: As per manufacturer std. (AL- LM6)
- Neoprene rubber pads: As required.
- Supporting frame for mounting: Required.
- Protective screen at inlet: Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh).
- Mounting flange on casing: At inlet and outlet.
- Painting / protecting coating – All the MS parts shall be galvanised or protected with three coats of epoxy paint.
- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of axial flow fan.

10.3 ROOF EXTRACTOR UNIT

- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of RE Unit.

10.4 Unitary Air Filtration

- Piping: MS Heavy class Galvanised to IS: 1239 Part I / IS 3589 depending on size.
- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of pipe.



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10.5 Valves:

- Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.
- Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
- Gate, Globe and stop check valves shall have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- All safety / relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
- Manual gear operators be provided for valves of size 200 NB and above.
- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of valve.

10.6 CENTRIFUGAL PUMP

- Impeller: Bronze as per Grade IS: 318 Grade 2
- Pump shaft: SS 316
- Casing: 2% Ni Cast iron to IS: 210 GR. FG-260.
- Shaft Sleeve: SS 316.
- Bolt and nuts: M.S. (Epoxy painted / Galvanised).
- Type of seal: Mechanical
- Pump motor coupling: Pin & bush type.
- Please refer to relevant clauses of Customer technical specification section C-2A for MOC of pump.

11. GENERAL

- 1) Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) Vendor to include the Back wash arrangement of pot strainer with gate valve, piping etc for the UAF.
- 5) Vendor to include level gauge & level transmitter for each UAF tank for alarm & trip of the pumps. Also include one no. Pressure transmitter for each UAF pump. Temperature elements, electronic transmitters etc. are to be provided for all the cases. Acceptance of use of process actuated switches is subject to customer approval.



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- 6) All commissioning spares & consumables for trouble free operation till handing over, shall be provided.
- 7) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 8) Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 9) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 10) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 11) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 12) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 13) Drain piping within room up to the drain point to be provided by the Vendor.
- 14) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 15) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 16) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 17) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 18) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 19) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 20) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied (as per attached instrumentation installation diagram)
- 21) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.



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- 22) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of air conditioning and ventilation system.
- Performance test of the Air conditioning system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for minimum 72 continuous hours in summer or monsoon and minimum 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
 - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.
- 23) For group of motorized fire damper / 3 Way valve actuators / motorised valves, single phase power supply shall be provided by BHEL in AHU room and near UAF. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 24) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 25) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to DCS / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.
- 26) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
- 27) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper internet connectivity at their end.
- 28) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 29) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 30) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.



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- 31) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 32) Supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 33) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 34) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 35) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 36) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering
- 37) Motorized fire damper will be installed at supply air duct in electrical areas like MCC / Switchgear room / cable spreader room etc. in FGD control building. Fire damper will close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Also UAF shall trip on receiving fire signal from fire protection system.
- 38) All openings required in brick wall for installing the axial supply and exhaust fans, propeller fans, duct opening, louvers and damper openings etc shall be done by BHEL as per opening sizes specified in technical specification. Any opening requirement on account of change in size of equipment over and above the opening size indicated as per opening sizes specified in technical specification, same shall be done by vendor along with finishing of opening and painting as per finished wall. Grouting of fans along with anchor fasteners shall be done by vendor. The openings shall be finished properly. In case openings are done once the wall have been painted, repainting, to match with the existing wall paint shall also be done by the vendor. Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Ventilation system vendor.
- 39) Flat, platform type RCC / PCC foundation shall be provided for installing UAF and UAF fan / pumps etc. Vendor shall fix the equipment using proper anchor fasteners to secure the equipment and obtain parameter related to vibration and noise.
- 40) All codes and standards shall be as per contract specifications
- 41) Wherever air washer is mentioned (in the complete technical specification) same shall be read as UAF and wherever chiller/chilling unit is mentioned (in the complete technical specification) same shall be read as air cooled condensing unit.



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12. EXCLUSIONS

Items of works listed below are excluded from scope of the HVAC system supplier.

- a) Construction of air handling unit room, foundations for HVAC equipment's.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of HVAC system vendor.
- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.

13. CODES AND STANDARDS

Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and codes including all addenda mentioned below:

IS-659 : Safety code for air-conditioning

IS-660 : Safety code for mechanical refrigeration

ASHRAE-23 : Standard method of testing and rating [67 Standards] air conditioner.

ARI-450-6 : Standards for water cooled refrigerant Condenser.

ASME Sec. VII : Unfired pressure vessels

IS-4503 : Shell and tube type heat exchanger.

ASHRAE 22-72 : Method of testing for rating water cooled refrigerant condenser.

ASHRAE-15-2007 : Safe Standard for Refrigeration System

ASHRAE-30-1995 : Method of testing liquid chilling packages

ANSI-8-31.5 : Refrigeration piping.

ANSI-8-9.1 : Safety code for mechanical refrigeration.

ARI-410 : Standard for air cooling and air heating coils.

ARI-210 : Standard for unitary air conditioning equipment.

IS-3588 : Specification for electrical axial flow fans.

AMCA-210 : Methods of performance test for fans.



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BS-2831 : Methods of test for air filters used in AC and general ventilation.

IS-4671 : Expanded polystyrene for thermal insulation purpose.

IS-702 : Industrial bitumen

IS-1239 : Heavy class Pipes for sizes up to 150 mm dia.

IS-8188 : For Water conditioning

IS-325 : 3 phase induction motors

IS-4029 : Guide line for testing 3 phase induction motor

IS-210 : Specification grey iron casting

IS-2062 : Structural steel

AMCA - Bulletin : Standard code of testing centrifugal and axial No. 210 flow fans

IS-2825 : Code of practice for welding mild steel

IS-2676 : Dimensions for wrought aluminum and aluminum alloy sheets and strips.

ASHRAE Code : For various filter

ASHRAE-62-2004 : Ventilation rates

IS-655 : Specification for metal air ducts

Pump design and testing should correspond to the procedure mentioned in IS-1520



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OPERATION AND MAINTENANCE SERVICES FOR HVAC SYSTEM



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1.0 OPERATION AND MAINTENANCE SERVICES

The bidder scope also covers the Operation and Maintenance (O&M) services for Preventive and Breakdown maintenance from the date of successful commissioning of HVAC System to end customer. However, actual date of start of O&M services shall be communicated to successful bidder by BHEL site personnel.

Bidder to note that the spares and consumables required for maintenance of the equipment during this O&M period shall be in bidder's scope of supply. Bidder shall use only genuine parts as mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of bidder and as a consequence of above bidder is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

O&M Services scope also covers all regular maintenance by certified and trained service engineers and supply of genuine parts and lubricants as per the original equipment manufacturer's recommendations in a pro-active manner.

For the purpose of Operation of HVAC System, One-day shall be considered as 24 hours i.e. 3 shifts of 8 hours each. The HVAC System (along with related accessories) shall be operated on Round-the-clock basis on all the days of the year including Sundays and Public Holidays

O & M Personnel should be acquainted with local language. Governmental / Statutory approval w.r.t. O&M service as applicable shall be in bidder's scope.

Total duration of the Operation and Maintenance services by Bidder can be increased or decreased as per requirement and payment in such case shall be made on pro-rata basis.

Depending on start of O&M services, there is a possibility that some period of O&M services and Warranty period may overlap. However, it is clarified that any maintenance required or any spare of HVAC System required to be replaced during Warranty period (as part of warranty clause requirement) shall not be made part of O&M Services. Bidder may take care of this fact while working out the prices of O&M services.

Wherever AC system has been written in O&M Service Specification, the same shall be deemed as complete HVAC System.

The vendor shall deploy following minimum manpower for Operation of HVAC System.

- i. One qualified and experienced AC operator per shift on "Round the Clock" basis throughout the year for all days of the year including Sundays & Public Holidays. There must be minimum 30 minutes overlapping between two shift operators to get familiarize with the status of HVAC System. Under normal circumstances one shift shall not be more than 8 hours.
- ii. One Helper per shift on " Round the Clock" basis throughout the year for all the days of the year including Sundays and Public Holidays. The helper shall assist the HVAC System Operator in day to day operation of HVAC System and accessories and shall assist him for keeping HVAC System equipment's in neat



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and tidy condition. Under normal circumstances one shift shall not be more than 8 hours

1.1 Responsibility of HVAC System Operator

- i. HVAC System operator shall be responsible for proper sequential operation of HVAC System (AC and Ventilation System) including operation of standby equipment in a predefined sequence and stopping the same (when necessary) as per the procedural practice. In case of any abnormality (like non availability of power supply at in-comer of HVAC System), he shall immediately report the matter to BHEL site Engineer for further action. Similarly, any malfunctioning in the system shall be immediately reported by him to BHEL site Engineer for suitable corrective action irrespective of time of occurrence of malfunctioning / abnormality in the system. A log book of all such outrages shall be maintained by HVAC system operator, which shall be shared with BHEL site engineer on periodic basis.
- ii. HVAC System operator shall take hourly readings of all the parameters of HVAC System / Equipment's including reading on main electrical panel of HVAC System. Temperature & RH readings inside all AC areas shall be taken at least once in a day. All the readings shall be recorded in a logbook register.

1.2 Responsibility of Helper.

- i. The HVAC System helper shall assist HVAC System operator for day to day smooth operation of HVAC System, like Checking of water levels of UAF Tank, cleaning of Tanks, cleaning of strainers, cleaning of AHU filters and other filters etc. as and when required. He shall be responsible for keeping all the equipment's of HVAC System including DX Unit & AHU rooms in clean and tidy condition. He shall also carry out general cleaning of all AC equipment's including Electrical Panels (Part of AC System), AHU's etc. on regular basis.
- ii. The helper shall work under the control of HVAC System operator and shall always ensure that unusable junk materials are not allowed to be kept in HVAC System room or AHU rooms. Under such eventuality, he will report the matter to Plant Operator, who in turn will take suitable action including reporting the matter to BHEL site Engineer.

1.3 All the log book registers shall be arranged by vendor. Log book register duly paged and bounded will be maintained in good condition by vendor.

1.4 All the necessary tools and other materials, required for operation of HVAC System shall be kept by vendor under the control of HVAC System operator. Required testing instruments like refrigerant leak detector, Multi Meter (for Electrical portion of HVAC System), Sling psychrometer, Line Tester, Tool Kit, Torch etc. should also be always available with Plant Operator.

1.5 In case of any operator / helper being on leave, vendor shall immediately take advance action and provide substitution so that minimum manpower as indicated



**3X200 MW + 3X500 MW RAMAGUNDAM
STPP, STG-1&2
(FGD SYSTEM PACKAGE)
HVAC SYSTEM
O&M SERVICES**

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above is not reduced on any day. In case a particular shift duty A/C Operator or helper does not turn up due to any reasons, the earlier duty person shall continue to make sure that HVAC System never remains unattended.

2.0 Maintenance of HVAC System

- i. Maintenance work under scope of the vendor shall broadly include but in no way limited to the following:
 - a) Preventive maintenance of the plant.
 - b) Servicing of the plant at regular interval including cleaning of AHU filters etc., Strainer, UAF Tanks etc.
 - c) Attending to complaints.
 - d) Replacement of worn out or defective components
 - e) Replacing of refrigerant gas and oil as and when required.

No consumable or any other items of HVAC system shall be arranged by Customer and no extra payment shall be made by customer in this regard.

- ii. Vendor shall be responsible at all time, during the entire period of contract for satisfactory performance of HVAC system (including accessories) with zero down time. During emergency or breakdown, vendor's Engineer along with related technicians shall be available immediately even though it may be beyond normal working hours or on public holidays till the HVAC System is restored back into normal satisfactory condition. Response time for attending breakdown complaints shall not exceed 2 hours.
- iii. Defective / worn out components shall be replaced only by genuine and original parts. OEM or its authorized dealer's invoice shall be submitted as proof of using genuine parts. All common spares required for HVAC system shall normally be kept available in the plant by the vendor. However, for critical spares, the same shall be made available in not more than 72 hours from the time of break-down requiring such spare.
- iv. Preventive Maintenance, servicing of HVAC System equipment's and accessories etc. shall be done by vendor in a planned manner in consultation with concerned customer's engineer. Preventive maintenance and service should be done as per the recommendations / guidelines of various OEMs
- v. Major servicing & over handling of equipment's like compressors, evaporators, condensers, pumps, AHU's, piping / ducting works, valves etc. shall be done by vendor once in a year.
- vi. Painting of all equipment's including base frames & accessories like piping, electrical panel boards etc. shall be done once in two years.



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- vii. In case any repair/services of particular equipment of system like chiller unit is to be carried out by vendor through OEM (or their authorized dealer), all the arrangements including tools, O&M spares etc. shall be the total responsibility of vendor.
- viii. Vendor shall arrange and maintain separate logbook register for services / maintenance of HVAC System. Record of work done for services/maintenance repairs etc. shall be recorded by vendor's engineer in this register. This register shall always be with updated records & shall be produced to customer's engineer on weekly basis or as & when required by him.
- ix. Vendor shall arrange and maintain sufficient stock of spares and consumable at site (HVAC room). Similarly, all necessary tools & instruments required for the purpose of servicing / maintenance / routine testing etc. shall also be arranged by vendor and should be available at site at all times.
- x. Repairs / servicing works shall normally be done by vendor at site up to maximum possible extent. However, in case any equipment or accessories is essentially required to be taken by vendor out of the plant premises for repairing / servicing, all necessary arrangements including to and fro transportation shall be the responsibility of vendor. Vendor shall also inform concerned customer's engineer for doing procedural formalities (like issue of gate pass etc.), prior to taking out the materials out of Plant premises.
- xi. In case bidder fails to supply the spares required for maintenance of the equipment, same shall be provided by BHEL at Bidders risk and cost.
- xii. Vendor shall be fully responsible for safety of his personal at all times. Vendor shall also be responsible for taking all safety precautions at all the times, especially during servicing / preventive maintenance and repairs of HVAC System equipment's etc.
- xiii. All the safety controls of AC Plant such as HP, LP, OP, Water pressure switch, inter locking etc. shall be positively checked at least once a month and same shall be recorded by vendor engineer
- xiv. Technicians & helpers engaged by the vendor shall wear uniform with nameplate for easy identification, while being within plant premises
- xv. Vendor's engineer shall be focal point for customer. He shall report to customer engineer on daily basis, for taking necessary instructions and to update the status of AC system
- xvi. If any damage to the equipment and its accessories has happened due to improper maintenance by bidder shall be recovered from the bidder.
- xvii. Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes etc. during the maintenance for the O&M Staff.



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
CUSTOMER SPECIFICATIONS**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C 2

REV. 00

**SECTION: I
SUB-SECTION: C 2
CUSTOMER SPECIFICATIONS**



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C 2A

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**SECTION: I
SUB-SECTION: C 2A
CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**


SUB-SECTION-III-A2


AIR CONDITIONING, VENTILATION SYSTEM &
~~COMPRESSED AIR SYSTEM~~


LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE


TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(3)-9


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	<p>AIR CONDITIONING SYSTEM</p> <p>a) General</p> <p>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.</p> <p>b) Air-conditioning system for F.G.D Control Room Building</p> <p>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 .</p> <p>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.</p> <p>d) Supply of Mandatory spares as specified.</p> <p>e) Any additional items required to make the system complete.</p> <p>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.</p> <p>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.</p> <p>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.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p align="center">SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM</p>	<p align="center">Page 1 of 4</p>	


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
<p>1.02.00</p> <p>Redundancies of equipments:</p> <p>100% standby unit shall be kept for FGD control room, analyzer room/Prota cabin (if required) and other air conditioned offices/areas.</p> <p>2.00.00</p>	<p>VENTILATION SYSTEM</p> <p>a) General</p> <p>The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Ventilation system consisting of Modular type Unitary air filtration Units, Supply air fans, water pumps, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.</p> <p>b) Non-A/C areas of F.G.D Control Room Building</p> <p>Minimum One (1) nos. of Evaporative type Unitary Air Filtration (UAF) unit (of metallic construction- modular type) of suitable capacity with all accessories, DIDW centrifugal fan (1 x 100%), circulating water pump (1 x 100%), etc. as detailed out in technical specification shall be provided.</p> <p>c) Miscellaneous areas: All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump & Oxidation blower/compressor building etc & all other 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. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.</p> <p>Note1: The above list of Buildings is indicative only. Any Building under this package which are of enclosed type, shall be provided by Mechanical ventilation.</p> <p>Note 2: If open shed is envisaged for any facility, then in that case no mechanical ventilation is required.</p> <p>d) Supply of Mandatory spares as specified.</p> <p>e) Any additional items required to make the system complete.</p> <p>f) For Ventilation 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 Contractor 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.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p>SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM</p>	<p>Page 2 of 4</p>	


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
<p>3.00.00</p> <p>COMPRESSED AIR SYSTEM</p> <p>4.00.00</p>	<p>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.</p> <p>a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD plant each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15Nm³/min at discharge pressure of 8.5 Kgf/cm² (g).</p> <p>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.</p> <p>c) Two number Air Receiver each of capacity 2 m³ (normal) at the discharge of each Air compressor.</p> <p>d) Monorail with electric hoist of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more.</p> <p>e) Complete instruments, control system with panels as required for compressed air system.</p> <p>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.</p> <p>g) Supply of Mandatory spares as specified.</p> <p>h) Any additional items required to make the system complete.</p> <p>General</p> <p>i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system.</p> <p>ii. Set of commissioning spares as may be required during erection and commissioning.</p> <p>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.</p> <p>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.</p> <p>v. Any additional items required to make the system complete.</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p>SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM</p>	<p>Page 3 of 4</p>


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	<p>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.</p> <p>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.</p> <p>Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p align="center">SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM</p>	<p align="center">Page 4 of 4</p>	


CLAUSE NO.	SALIENT DESIGN DATA			
<p>6.00.00</p> <p>AIR CONDITIONING SYSTEM</p> <p>GENERAL REQUIREMENTS</p> <ol style="list-style-type: none"> 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. <p>6.01.00</p> <p>DESIGN PHILOSOPHY FOR AIR CONDITIONING</p> <ol style="list-style-type: none"> 1. Design ambient conditions for all air conditioning system shall be as per Appendix-A. 2. All equipments of Air Conditioning system shall be designed for continuous duty. 3. All air conditioned areas shall be maintained at 24 deg. C \pm (plus or minus) 1 deg. C and relative humidity of 50% \pm (plus or minus) 5%. 4. The fresh air quantity for air-conditioned areas of FGD Control Room etc. shall be 0.45 M³/minutes/person or 1.5 air change per hour whichever is greater. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units. 5. Lighting load shall be minimum 2 Watts/Sq. feet. 6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum). 7. In Air conditioning system for FGD Control Room, return air shall be routed back to AHU room through plenum space. 8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder. 				
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V SALIENT DESIGN DATA</p>	<p>PAGE 14 OF 23</p>	

CLAUSE NO.	SALIENT DESIGN DATA			
<p>6.02.00</p> <p>6.02.01</p>	<p>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.</p> <p>10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec.</p> <p>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.</p> <p>12. Requirement of Underdeck Insulation (for A/C area)</p> <p>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</p> <ul style="list-style-type: none"> 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. <p>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.</p> <p>14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area.</p> <p>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 type A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided.</p> <p>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.</p> <p>REDUNDANCY OF EQUIPMENTS</p> <p>Redundancy of various A/C system equipments shall be as follows:</p> <p>a) FGD Control Room Building</p> <ul style="list-style-type: none"> i) Air Cooled condensing units Air conditioners: 2X100% 4 * 50% ii) AHU: 2 X 100% 4 * 50% <p>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</p> <p>c) Fresh air fans shall be 2 * 50% Capacity for each AHU room.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V SALIENT DESIGN DATA</p>	<p>PAGE 15 OF 23</p>	

CLAUSE NO.	SALIENT DESIGN DATA															
6.03.00	<p>DESIGN PHILOSOPHY – Ventilation System</p> <p>1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:</p> <table border="0" data-bbox="416 465 1246 589"> <tr> <td>i)</td> <td>For all evaporative cooled areas</td> <td>-</td> <td>8</td> </tr> <tr> <td>ii)</td> <td>General areas</td> <td>-</td> <td>20</td> </tr> <tr> <td>iii)</td> <td>MCC / Switchgear rooms and Battery rooms & other areas where gaseous fumes/ vapours are generated</td> <td>-</td> <td>30</td> </tr> </table> <p>2. However in areas producing lot of heat, temperature shall be the criteria as follows:-</p> <p>a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.</p> <p>b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>4. All the equipments of Ventilation system shall be designed for continuous duty.</p> <p>5. The supply air ducts of evaporative type ventilation system entering into switchgear room, cable galleries etc. shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating). Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to</p>			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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<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V SALIENT DESIGN DATA</p>	<p>PAGE 16 OF 23</p>												

CLAUSE NO.	SALIENT DESIGN DATA			
	<p>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.</p> <p>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.</p> <p>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.</p> <p>8. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-V SALIENT DESIGN DATA</p>	<p align="center">PAGE 17 OF 23</p>	

CLAUSE NO.	SALIENT DESIGN DATA			
	Appendix-A Outside Design Ambient condition to be considered for Air Conditioning system and Ventilation System for various project/station are as under.			
	Location	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
	Ramagundam	Summer	45	27.5
		Monsoon	35.8	28.3
Winter		12.8	8.9	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 18 OF 23	


CLAUSE NO.	SALIENT DESIGN DATA			
<p>7.00.00</p> <p>7.01.00</p> <p>7.02.00</p>	<p>Fire Detection and Protection System</p> <p>General Design Criteria</p> <p>All major equipment/ system components in the entire fire protection & detection system shall have the approval from one of the following:</p> <p>a) Underwriters laboratories of USA</p> <p>b) LPCB-UK</p> <p>c) VDS</p> <p>d) BIS (for the approval of pumps and valves as applicable)</p> <p>e) FM- USA</p> <p>However design and installation of complete system and requirements shall be approved by TAC accredited professional(s)-India.</p> <p>Hydrant System</p> <p>Design philosophy (minimum requirement)</p> <p>i) Category of Hazard and minimum terminal pressure shall be as TAC norms.</p>			
<p>LOT-3 PROJECTS</p> <p>FLUE GAS DESULPHURISATION (FGD)</p> <p>SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION</p> <p>SECTION – VI, PART-A</p> <p>BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V</p> <p>SALIENT DESIGN DATA</p>	<p>PAGE 19 OF 23</p>	

~~SUB-SECTION-I-M2~~

AIR CONDITIONING & VENTILATION SYSTEM

**LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(3)-9**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL			
1.01.00	<p>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.</p> <p>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.</p>			
2.00.00	AREAS TO BE AIR CONDITIONED			
2.01.00	<p>The areas to be air-conditioned shall be as follows:</p> <p>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.</p> <p>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.</p>			
3.00.00	AREAS TO BE VENTILATED			
3.01.00	<p>(i) Modular type UAF units of suitable capacity (2 * 50%) 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.</p> <p>(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:</p> <p>a) Grinding system building</p> <p>b) Gypsum dewatering building</p> <p>c) Recirculation pump & Oxidation blower/compressor building.</p> <p>(iii) Toilets etc in above building (i) & (ii). Any other area not listed above but covered in the scope of Bidder.</p> <p>(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.</p>			
3.02.00	<p>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:</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM</p>	<p>Page 1 of 26</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
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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

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.


Capacity : Minimum capacity shall be suitable for the identified/selected at evaporating temperature and


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CLAUSE NO.	TECHNICAL REQUIREMENTS 				
4.02.00 4.02.01 4.02.02 4.02.03 4.02.04 4.02.05 4.02.06	<p style="text-align: center;">condensing temperature and shall be indicated.</p> <p>Air Handling Unit (AHU)</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Centrifugal fan for AHU</p> <p>a) Fan Type : Double Width Double Inlet (DWDI) Centrifugal Type</p> <p>b) Fan impeller : Backward curved blades</p> <p>c) Casing material : GI /Mild steel with minimum thickness of 3 mm.</p> <p>d) Impeller material : Carbon steel</p> <p>e) Shaft : EN 8 Steel</p>	LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 3 of 26


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/m ³ 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: <ul style="list-style-type: none"> 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. 			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 4 of 26	


CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.03.02	<p>viii) Controls, instruments, control panel/starter panels.</p> <p>ix) Vibration isolator pads, etc as required.</p> <p>x) Refrigerant as per manufacturer practice.</p> <p>Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):</p> <p>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.</p> <p>Unit shall have four way supply air grills on sides and return air grill in center.</p> <p>Each unit shall have high lift drain pump and very low operating sound.</p>			
4.04.00	SPLIT/PACKAGED AIR CONDITIONERS			
4.04.01	<p>Split/package air conditioners shall in general consist of following:</p> <ol style="list-style-type: none"> 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	<p>Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellent 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.</p>			
5.01.02	<p>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.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM</p>	<p>Page 5 of 26</p>	


CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.01.03	<p>The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized (minimum 60 microns DFT). Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.</p>		
5.01.04	<p>The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area.</p>		
5.01.05	<p>Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanized. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc.</p>		
5.01.06	<p>The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomised spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm².</p>		
5.01.07	<p>The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilised using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanized steel or PVC construction and shall be complete with suitable drip tray and drain pipe.</p>		
5.01.08	<p>Air tight inspection doors of suitable size shall be provided for suction chamber. Spray chamber and fan suction for easy accessibility and maintenance and a water marine light be provided for each unitary air filtration.</p>		
5.01.09	<p>Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement.</p>		
5.01.10	<p>The specification for centrifugal fans shall generally be as indicated below. However, the fan shall be of DIDW type for UAF unit.</p>		
5.01.11	<p>Saturation efficiency of Unitary Air Filtration units shall be minimum 60%.</p>		
5.02.00	Centrifugal Fan		
5.02.01	<p>The casing shall be of welded construction fabricated with heavy gauge galvanized sheet steel or MS sheet with spray galvanization (minimum 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.</p> <p>The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.02.02	The bearing shall be self aligning, heavy duty 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
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM</p>	<p align="center">Page 7 of 26</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<ul style="list-style-type: none"> 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 m ³ /hr & lower shall be of propeller exhaust type.		
6.00.00	BALANCE EQUIPMENT SPECIFICATION		
6.01.00	Material of Construction for Piping & Fittings		
	<ul style="list-style-type: none"> 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 		
	<ul style="list-style-type: none"> 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). 		
	<ul style="list-style-type: none"> c) Drain piping : Same as (a) above & galvanized as per IS:4736. 		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p style="text-align: center;">SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM</p>	<p style="text-align: center;">Page 8 of 26</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>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.</p> <p>2) For sizes 50 NB and below, the material shall conform to ASTM A-105.</p> <p>3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5</p> <p>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.</p> <p>5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5</p>		
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		
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM</p>	<p align="center">Page 9 of 26</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS 		
6.03.02	<p>expanded metal on exit side or G.I. wire mesh on both sides.</p> <p>3) Other requirements : (as applicable)</p> <p>a) Suitable aluminium spacers be provided for uniform air flow;</p> <p>b) Casing shall be provided with neoprene sponge rubber sealing.</p> <p>c) Capable of being cleaned by water flushing.</p> <p>d) Density of filter medium shall increase in the direction of air flow in case of metallic filter.</p> <p>e) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.</p> <p>4) Efficiency :</p> <p>Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.</p> <p>5) Minimum thickness : 50 mm</p> <p>6) Face Velocity : Not more than 2.5 m/sec.</p> <p>7) Pressure drop : Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.</p> <p>8) Location : a) At the suction of each AHUs : b) At the suction of each Fresh air fan</p> <p>Fine Filters (Microvee type)</p> <p>1) Type : Flange / Cassette</p> <p>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.</p> <p>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.</p>		
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	<p>4) Efficiency : Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE-52-76 / EN-779.</p> <p>5) Minimum thickness : 150 mm or 300 mm.</p> <p>6) Face Velocity : Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.</p> <p>7) Pressure drop : Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.</p> <p>8) Location : i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan.</p>																				
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: <table border="1" data-bbox="384 1088 1390 1346"> <thead> <tr> <th>Larger Dimension of duct (mm)</th> <th>Thickness of GI sheet(mm)</th> <th>Thickness of Aluminium sheet (mm)</th> </tr> </thead> <tbody> <tr> <td>up to 750 mm</td> <td>0.63 (24 G)</td> <td>0.80</td> </tr> <tr> <td>751 to 1500</td> <td>0.80 (22 G)</td> <td>1.00</td> </tr> <tr> <td>1501 to 2250</td> <td>1.00 (20 G)</td> <td>1.50</td> </tr> <tr> <td>2251 & above</td> <td>1.25 (18 G)</td> <td>1.80</td> </tr> </tbody> </table>			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			
Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)																			
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6.04.03	Thickness of round ducts shall be as follows: <table border="1" data-bbox="384 1435 1390 1805"> <thead> <tr> <th>Diameter of Round duct (mm)</th> <th>Thickness of GI sheet(mm)</th> <th>Thickness of Aluminium sheet (mm)</th> </tr> </thead> <tbody> <tr> <td>150 to 500</td> <td>0.63</td> <td>0.80</td> </tr> <tr> <td>501 to 750</td> <td>0.80</td> <td>1.00</td> </tr> <tr> <td>751 to 1000</td> <td>0.80</td> <td>1.00</td> </tr> <tr> <td>1001 to 1250</td> <td>1.00</td> <td>1.50</td> </tr> <tr> <td>1251 & above</td> <td>1.25</td> <td>1.80</td> </tr> </tbody> </table>			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
Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)																			
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1251 & above	1.25	1.80																			
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6.04.04	<p>Duct Fabrication and Supports:</p> <p>a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.</p> <p>b) Ducts for A/C system may be site fabricated or factory fabricated.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>			
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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CLAUSE NO.	TECHNICAL REQUIREMENTS																		
<p>6.04.06</p> <p>6.05.00</p> <p>6.05.01</p> <p>6.05.02</p> <p>6.05.03</p>	<p>sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.</p> <p>Factory fabricated ducts :</p> <p>i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I.</p> <p>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)</p> <p>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:</p> <p>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.</p> <p>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.</p> <p>c) All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges.</p> <p>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</p> <p>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.</p> <p>v) Factory fabricated ducts shall have the thickness of the sheet as follows:</p> <table border="1" data-bbox="453 1391 1150 1585"> <thead> <tr> <th>Sl.No.</th> <th>Size of Duct</th> <th>Sheet Thickness</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Diffusers, Grills & Dampers :</p> <p>Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas.</p> <p>Return air diffusers of air-conditioned areas shall be without volume control dampers.</p> <p>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.</p>			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																	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
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.		
6.06.0	Thermal and Acoustic Insulation		
6.06.01	<p>A) <u>Application with Glass Wool / Rockwool</u></p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(iv) Insulation Finish of types specified under shall be provided thereafter..</p> <p>B) <u>Application with Nitrile Rubber</u></p> <p>(i) All surfaces to be insulated shall be properly cleaned.</p> <p>(ii) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.</p> <p>(iii) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.</p> <p>(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.</p> <p>C) <u>Application with Polyurethane Foam & Polyisocyanurate Foam</u></p> <p>i) All surfaces to be insulated shall be cleaned.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
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 drain pipe	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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CLAUSE NO.	TECHNICAL REQUIREMENTS					
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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CLAUSE NO.	TECHNICAL REQUIREMENTS					
6.06.03	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
			Foam			
6.06.03	Specification for insulation shall be as follows: -					
6.06.04	Insulation Material	Code	Thermal conductivity (w/m/°C)	Density Kg/m ³		
	Resin bonded glass wool	IS:8183	0.049 at 50°C 0.043 at 50°C	i) 24 (For Glass wool) 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	The specification for various finishes shall be as follows					
a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)					
	<u>Step-1</u>	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.				
	<u>Step-2</u>	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			
		<p><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.</p>	<p>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</p>	
	<p>b)</p>	<p>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.</p>	<p>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.</p>	
	<p>d)</p>	<p>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.</p>	<p>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.</p>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
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 gysterstat 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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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
7.06.00	<p>Miscellaneous Control Requirements</p> <p>a) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.</p> <p>b) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD control system.</p>			
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			
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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: <table border="1" data-bbox="376 622 1230 741"> <thead> <tr> <th>Speed</th> <th>Antifriction Bearing</th> <th>Sleeve Bearing</th> </tr> </thead> <tbody> <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> </tbody> </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.			Speed	Antifriction Bearing	Sleeve Bearing	1500 rpm and below	75.0 micron	75.0 micron	3000 rpm	50.0 micron	65.0 micron	
Speed	Antifriction Bearing	Sleeve Bearing											
1500 rpm and below	75.0 micron	75.0 micron											
3000 rpm	50.0 micron	65.0 micron											
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 		
	<p style="text-align: right;">Annexure –I</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Annexure –I		
g)	Bearings		
	<p>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.</p>		
	<p>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.</p>		
	<p>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.</p>		
	<p>Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.</p>		
h)	Stuffing Boxes		
	<p>Stuffing box design should permit replacement of packing without removing any part other than the gland.</p>		
	<p>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.</p>		
i)	Mechanical Seals		
	<p>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.</p>		
j)	Pump Seal		
	<p>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.</p>		
k)	Pump Shaft Motor Shaft Coupling		
	<p>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.</p>		
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 24 of 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<p style="text-align: right;">Annexure –I</p> <p>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.</p> <p>m) Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.</p> <p>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).</p>		
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 25 of 26

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



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
PROJECT SPECIFIC GENERAL
REQUIREMENTS**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C 2B

REV. 00

**SECTION: I
SUB-SECTION: C 2B
CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS**

NTPC Limited

(A Government of India Enterprise)



LOT-3 PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(3)-9

NTPC Limited

(A Government of India Enterprise)



LOT-3 PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(3)-9

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

PART - C

GENERAL TECHNICAL REQUIREMENTS

LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-C
BID DOC NO: CS-0011-109(3)-9

GENERAL TECHNICAL REQUIREMENTS

PART - C


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1.00.00	<p>INTRODUCTION</p> <p>This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.</p>			
2.00.00	<p>BRAND NAME</p> <p>Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.</p>			
3.00.00	<p>BASE OFFER & ALTERNATE PROPOSALS</p> <p>The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.</p>			
4.00.00	<p>COMPLETENESS OF FACILITIES</p>			
4.01.00	<p>Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.</p>			
4.02.00	<p>All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.</p> <p>All same standard components/ parts of same equipment provided, shall be interchangeable with one another.</p>			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	RULES, REGULATIONS, CODES & STANDARDS			
5.01.00	<p>In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following:</p> <ul style="list-style-type: none"> a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976, 			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.02.00	<p>(p.) Gas Cylinder Rules, 1981</p> <p>(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981</p> <p>(r.) Workmen's Compensation Act, 1923</p> <p>(s.) Workmen's Compensation Rules, 1924</p> <p>(t.) NTPC Safety Rules for Construction and Erection</p> <p>(u.) NTPC Safety Policy</p> <p>(v.) Any other statutory codes / standards / regulations, as may be applicable.</p> <p>Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:</p> <p>a) Bureau of Indian standards (BIS)</p> <p>b) Japanese Industrial Standards (JIS)</p> <p>c) American National Standards Institute (ANSI)</p> <p>d) American Society of Testing and Materials (ASTM)</p> <p>e) American Society of Mechanical Engineers (ASME)</p> <p>f) American Petroleum Institute (API)</p> <p>g) Standards of the Hydraulic Institute, U.S.A.</p> <p>h) International Organisation for Standardisation (ISO)</p> <p>i) Tubular Exchanger Manufacturer's Association (TEMA)</p> <p>j) American Welding Society (AWS)</p> <p>k) National Electrical Manufacturers Association (NEMA)</p> <p>l) National Fire Protection Association (NFPA)</p> <p>m) International Electro-Technical Commission (IEC)/European Norm (EN)</p> <p>n) Expansion Joint Manufacturers Association (EJMA)</p> <p>o) Heat Exchange Institute (HEI)</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 3 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.03.00	p) IEEE standard q) JEC standard	<p>Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.</p>		
5.04.00	Not used.			
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.			
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.			
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.			
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.			
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE			
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
8.02.00	<p>engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.</p> <p>Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.</p> <p>The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.</p> <p>A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.</p> <p>The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification.</p>			
8.03.00	<p>The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:</p>			
8.03.01	<p>A) BASIC ENGINEERING DOCUMENTATION</p> <p>Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:</p> <ul style="list-style-type: none"> i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. 			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope.</p> <p>ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.</p> <p>x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder.</p> <p>xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.</p> <p>The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.</p> <p>B) DETAILED ENGINEERING DOCUMENTS</p> <p>i) General layout plan of the FGD System.</p> <p>ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.</p> <p>iii) Flow diagram, process and instrumentation diagrams along with write up and system description.</p> <p>iv) Performance curves for Absorber</p> <p>v) Piping isometric, composite layout and fabrication drawings.</p> <p>vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.</p> <p>vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.</p> <p>viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc- as per criteria specified elsewhere in specification.</p> <p>ix) Absorber sizing calculations. Absorber performance data.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 7 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<ul style="list-style-type: none"> x) Mass Balance Diagram xi) Characteristic Curves/ Performance Correction Curves. xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xiv) Protection system diagrams and relay settings. xv) Cables schedules and interconnection diagrams. xvii) Cable routing plan. xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points. xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. xxiii) Detailed Control system manuals. xxiv) Detailed flow chart for digital control system. xv) Mimic diagram layout, Assignment for other application engg. drawings and documents. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the 			
<p align="center"> LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE </p>	<p align="center"> TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9 </p>	<p align="center"> PART-C GENERAL TECHNICAL REQUIREMENTS </p>	<p align="center"> PAGE 8 OF 83 </p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
8.03.02	<p>scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.</p> <p>xxvii) Underground facilities, levelling, sanitary, land scaping drawings.</p> <p>xxviii) Geotechnical investigation and site survey reports (if and as applicable).</p> <p>xxix) Model study reports wherever applicable.</p> <p>xxx) Functional & guarantee test procedures and test reports.</p> <p>xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.</p> <p>xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance.</p> <p>The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.</p> <p>INSTRUCTION MANUALS</p> <p>The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.</p> <p>A) ERECTION MANUALS</p> <p>The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.</p> <p>a) Erection strategy.</p> <p>b) Sequence of erection.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 9 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>c) Erection instructions.</p> <p>d) Critical checks and permissible deviation/tolerances.</p> <p>e) List of tool, tackles, heavy equipments like cranes, dozers, etc.</p> <p>f) Bill of Materials</p> <p>g) Procedure for erection and General Safety procedures to followed during erection/installation.</p> <p>h) Procedure for initial checking after erection.</p> <p>i) Procedure for testing and acceptance norms.</p> <p>j) Procedure / Check list for pre-commissioning activities.</p> <p>k) Procedure / Check list for commissioning of the system.</p> <p>l) Safety precautions to be followed in electrical supply distribution during erection.</p> <p>B) OPERATION & MAINTENANCE MANUALS</p> <p>a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.</p> <p>b) The arrangement and contents of O & M manuals shall be as follows:</p> <p>1) <u>Chapter 1 - Plant Description</u>: To contain the following sections specific to the equipment/system supplied</p> <p>(a) Description of operating principle of equipment / system with schematic drawing / layouts.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 10 OF 83</p>	


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	<p>(b) Functional description of associated accessories / controls. Control interlock protection write up.</p> <p>(c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).</p> <p>(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.</p> <p>(e) Design data against which the plant performance will be compared.</p> <p>(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.</p> <p>(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).</p> <p>(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).</p> <p>2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied</p> <p>(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.</p> <p>(b) Limiting values of all protection settings.</p> <p>(c) Various settings of annunciation/interlocks provided.</p> <p>(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.</p> <p>(e) Do's and Don'ts related to operation of the equipment.</p> <p>(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.</p> <p>(g) Parameters to be monitored with normal value and limiting values.</p> <p>(h) Equipment isolating procedures.</p>			
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	<p>(i) Trouble shooting with causes and remedial measures.</p> <p>(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.</p> <p>(k) Routine Operational Checks, Recommended Logs and Records</p> <p>(l) Change over schedule if more than one auxiliary for the same purpose is given.</p> <p>(m) Preservation procedure on long shut down.</p> <p>(n) System/plant commissioning procedure.</p> <p>3) <u>Chapter 3.0 - Plant Maintenance-</u> To contain the following sections specific to the equipment supplied.</p> <p>(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.</p> <p>(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.</p> <p>(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.</p> <p>(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.</p> <p>(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.</p> <p>(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.</p> <p>(g) Long term maintenance schedules</p> <p>(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.</p> <p>(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at</p>			
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8.03.03	<p>longer intervals to ensure trouble free operation and quantity required for complete replacement.</p> <ul style="list-style-type: none"> (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied. <p>After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.</p> <p>If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.</p>			
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT			
8.03.03.01	PLANT HANDBOOK			
	<p>The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including</p> <ul style="list-style-type: none"> i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams. 			
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	iv) Sequence & Protection Interlock Schemes. v) Alarm and trip values. vi) Performance Curves. vii) General layout plan and layout of main plant building and auxiliary buildings viii) Important Do's & Don't's	<p>The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.</p>	
8.03.03.02	PROJECT COMPLETION REPORT		
	<p>The Contractor shall submit a Project Completion Report at the time of handing over the plant.</p>		
8.03.04	DRAWINGS <p>a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.</p> <p>ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.</p> <p>Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.</p> <p>The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.</p> <p>iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C.</p> <p>iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all</p>		
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	<p>facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference.</p> <p>Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.</p> <p>b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable.</p> <p>c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.</p> <p>d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.</p> <p>e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.</p>			
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	<p>The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".</p> <p>Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.</p> <p>f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.</p> <p>g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.</p> <p>h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.</p> <p>i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.</p>			
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	<p>Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.</p> <p>j) As Built Drawings</p> <p>After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per Annexure VI.</p> <p>k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.</p> <p>l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.</p> <p>m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.</p> <p>n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.</p>			
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8.04.00	<p>ENGINEERING INFORMATION SUBMISSION SCHEDULE</p> <p>Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.</p> <p>i) Information that shall be submitted for the approval to the Employer before proceeding further, and</p> <p>ii) Information that would be submitted for Employer's information only.</p> <p>The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.</p> <p>The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.</p>			
8.05.00	<p>ENGINEERING PROGRESS AND EXCEPTION REPORT</p>			
8.05.01	<p>The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including</p> <p>a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission</p> <p>b) Drawings which were not submitted as per agreed schedule.</p>			
8.05.02	<p>The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.</p>			
8.06.00	<p>Engineering Co-ordination Procedure</p>			
8.06.01	<p>The following principal coordinators will be identified by respective organizations at time of award of contract:</p> <p>NTPC Engineering Coordinator (NTPC EC):</p>			
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	<p>Name :</p> <p>Designation :</p> <p>Address :</p> <p>a) Postal :</p> <p>b) Telegraphic / e-Mail :</p> <p>c) FAX : TELEPHONE :</p> <p>Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):</p> <p>Name :</p> <p>Designation :</p> <p>Address :</p> <p>a) Postal :</p> <p>b) Telegraphic / e-Mail :</p> <p>c) FAX : TELEPHONE :</p>			
8.06.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.			
8.06.03	<p>Contractor's/Vendor's Drawing Submission and Approval Procedure:</p> <p>a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".</p> <p>b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.</p> <p>c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.</p>			
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	<p>d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.</p> <p>e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.</p> <p>f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.</p> <p>g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :</p> <p>CATEGORY- I: Approved</p> <p>CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.</p> <p>CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.</p> <p>CATEGORY -IV For information and records.</p> <p>h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number</p>			
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	<p>enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.</p> <p>i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.</p> <p>j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.</p> <p>k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.</p> <p>l) These comments will be taken care by the contractor while submitting the revised drawing.</p> <p>The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.</p>			
9.00.00	TECHNICAL CO-ORDINATION MEETING			
9.01.00	<p>The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.</p>			
9.02.00	<p>The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The</p>			
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	<p>comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.</p>			
9.02.01	<p>The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.</p>			
9.02.02	<p>Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.</p>			
9.03.0	<p>Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.</p>			
10.00.00	<p>DESIGN IMPROVEMENTS</p> <p>The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.</p> <p>If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.</p>			
11.00.00	<p>EQUIPMENT BASES</p> <p>A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.</p>			
12.00.00	<p>PROTECTIVE GUARDS</p> <p>Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.</p>			
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13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	<p>I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.</p> <p>Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container.</p>			
13.02.00	<p>As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.</p> <p>Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.</p>			
14.00.00	LUBRICATION			
14.01.00	<p>Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.</p>			
15.00.00	MATERIAL OF CONSTRUCTION			
15.01.00	<p>All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.</p>			
16.00.00	RATING PLATES, NAME PLATES & LABELS			
16.01.00	<p>Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.</p>			
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16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.			
16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
16.07.00	<p>Safety and relief valves shall be provided with the following:</p> <ul style="list-style-type: none"> a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute. 			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
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17.00.00	<p>TOOLS AND TACKLES</p> <p>The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.</p> <p>The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.</p>			
18.00.00	<p>WELDING</p>			
18.01.00	<p>If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.</p>			
19.00.00	<p>COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES</p>			
19.01.00	<p>All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.</p>			
20.00.00	<p>PROTECTION AND PRESERVATIVE SHOP COATING</p>			
20.01.00	<p>PROTECTION</p> <p>All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for</p>			
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	<p>painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.</p>			
20.02.00	<p>PRESERVATIVE SHOP COATING</p>			
	<p>All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.</p>			
	<p>Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.</p>			
20.03.00	<p>Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.</p>			
20.04.00	<p>All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.</p>			
20.05.00	<p>All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.</p>			
20.06.00	<p>Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.</p>			
21.00.00	<p>QUALITY ASSURANCE PROGRAMME</p>			
21.01.00	<p>To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A</p>			
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<p>22.00.00</p> <p>22.01.00</p>	<p>quality assurance programme of the contractor shall generally cover the following:</p> <ul style="list-style-type: none"> a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively. <p>GENERAL REQUIREMENTS - QUALITY ASSURANCE</p> <p>All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of</p>			
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	<p>inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.</p>			
22.02.00	<p>Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)</p>			
22.03.00	<p>Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).</p>			
22.04.00	<p>The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.</p>			
22.05.00	<p>The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.</p>			
22.06.00	<p>The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP)</p>			
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	<p>and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.</p>			
22.07.00	<p>No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).</p>			
22.08.00	<p>All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details</p>			
22.09.00	<p>All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.</p> <p>All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.</p>			
22.10.00	<p>All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.</p>			
22.11.00	<p>Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.</p>			
22.12.00	<p>For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding</p>			
22.13.00	<p>All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.</p>			
22.14.00	<p>No welding shall be carried out on cast iron components for repair.</p>			
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22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
22.16.00	<p>All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.</p> <p>In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.</p>			
22.17.00	<p>The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.</p>			
22.18.00	<p>For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.</p> <p>Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the</p>			
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	<p>monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.</p>			
22.19.00	<p>Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.</p>			
22.20.00	<p>The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.</p>			
22.21.00	<p>Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.</p>			
22.22.00	<p>For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.</p>			
22.23.00	<p>Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.</p>			
22.24.00	<p>Environmental Stress Screening</p> <p>Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.</p>			
22.25.00	<p>The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.</p>			
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22.26.00	<p>Software Reliability / Quality Certification</p> <p>Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.</p>			
23.00.00	<p>QUALITY ASSURANCE DOCUMENTS</p>			
23.01.00	<p>The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.</p>			
23.01.01	<p>Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.</p> <p>The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.</p> <p>The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.</p>			
23.02.00	<p>Typical contents of QA Documentation is as below:-</p> <ul style="list-style-type: none"> (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. 			
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<p>23.03.00</p> <p>23.04.00</p> <p>23.05.00</p>	<p>(h.) Certificate of Conformance (COC) wherever applicable.</p> <p>(i.) MDCC</p> <p>Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.</p> <p>Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.</p> <p>(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.</p> <p>(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.</p> <p>(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.</p> <p>TRANSMISSION OF QA DOCUMENTATION</p> <p>On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.</p> <p>For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.</p>			
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24.00.00	PROJECT MANAGER'S SUPERVISION			
24.01.00	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.			
24.02.00	<p>The work shall be performed under the supervision of the Project Manager.</p> <p>The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:</p> <ul style="list-style-type: none"> (a.) Interpretation of all the terms and conditions of these documents and specifications (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works. 			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain			
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25.03.00	<p>for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.</p> <p>The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.</p>			
25.04.00	<p>The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.</p>			
25.05.00	<p>When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.</p>			
25.06.00	<p>In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.</p>			
25.07.00	<p>The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 35 OF 83</p>	


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25.08.00	<p>To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.</p>			
25.09.00	<p>All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.</p>			
25.10.00	<p>Associated document for Quality Assurance programme</p>			
25.10.01	<p>Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.</p>			
25.10.02	<p>Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.</p>			
25.10.03	<p>List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).</p>			
25.10.04	<p>Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.</p>			
25.10.05	<p>Field Welding Schedule Format enclosed at Annexure-V.</p>			
25.11.00	<p>Not Used</p>			
25.12.00	<p>DEMONSTRATION OF APPLICATION ENGINEERING</p>			
25.12.01	<p>Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.</p> <p>(i) Logics/Loops:</p> <ul style="list-style-type: none"> a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. 			
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<p>25.12.02</p> <p>25.12.03</p> <p>26.00.00</p> <p>26.01.00</p>	<p>e) Master slave implementation with different slave combination.</p> <p>f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.</p> <p>(ii) HMI Functions:</p> <p>a) LVS Annunciation.</p> <p>b) Graphics.</p> <p>c) HSR</p> <p>d) Logs/Reports.</p> <p>e) Calculations (Basic & Performance Calculations).</p> <p>The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.</p> <p>After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.</p> <p>During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.</p> <p>PRE-COMMISSIONING AND COMMISSIONING FACILITIES</p> <p>(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.</p>			
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26.01.00	<p>(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.</p> <p>(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.</p> <p>(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.</p> <p>(e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(standard check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer.</p> <p>(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.</p> <p>Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least twelve months prior to the schedule date of commissioning of 1st unit. The chart should contain:</p> <p>(1.) Biodata including experience of the Commissioning Engineers.</p> <p>(2.) Role and responsibilities of the Commissioning Organisation members.</p> <p>(3.) Expected duration of posting of the above Commissioning Engineers at site.</p>			
26.02.00	<p>Initial Operation</p> <p>(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during</p>			
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26.03.00	<p>which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.</p> <p>(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours.</p> <p>The Initial Operation shall be considered successful, provided that each item/part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.</p> <p>The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.</p> <p>(c) Any operational interruption in the FGD System due to constraints attributable to the Employer shall be construed as Deemed to be in operation.</p> <p>(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.</p> <p>Guarantee Tests</p> <p>a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with the Initial Operations.</p>			
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	<p>b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.</p> <p>c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.</p> <p>d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.</p> <p>e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.</p>			
27.00.00	<p>TAKING OVER</p> <p>Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.</p>			
28.00.00	<p>TRAINING OF EMPLOYER'S PERSONNEL</p>			
28.01.00	<p>Training for Employers O&M Personnel</p> <p>The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance.</p> <p>Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.</p>			
28.02.00	<p>Training for Employers Engineering Personnel</p> <p>The scope of services under training for Employer's engineering personnel shall also necessarily include three (3) man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like</p>			
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	<p>Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.</p>			
28.03.00	<p>Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above (i.e. 6 man months and 3 man months respectively for O&M and Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.</p>			
28.04.00	<p>Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.</p>			
28.05.00	<p>In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.</p>			
28.06.00	<p>Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.</p> <p>Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.</p>			
29.00.00	<p>SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION</p> <p>In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:</p> <ul style="list-style-type: none"> i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection. 			
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30.00.00	<p>NOISE LEVEL</p> <p>The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable:</p> <p>a) Ball Mill < 90 dBA</p>			
31.00.00	<p>PACKAGING AND TRANSPORTATION</p> <p>All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.</p>			
32.00.00	<p>ELECTRICAL EQUIPMENTS/ENCLOSURES</p>			
32.01.00	<p>All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.</p>			
33.00.00	<p>INSTRUMENTATION AND CONTROL</p> <p>All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.</p>			
33.01.00	<p>All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.</p> <p>All scales and charts shall be calibrated and printed in Metric Units as follows:</p> <p>1 Temperature - Degree centigrade (deg C)</p>			
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	2. Pressure 3. Draught 4. Vacuum 5. Flow (Gas) 6. Flow (Steam) 7. Flow (Liquid) 8. Flow base 9. Density	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure. - Millimetres of water column (mm wc). - Millimeters of mercury gauge (mm Hg) or water column (mm Wcl). - Tonnes/ hour - Tonnes/ hour - Tonnes / hour - 760 mm Hg. 0 deg.C - Grams per cubic centimeter.		
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.			
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.			
34.00.00	<p>ELECTRICAL NOISE CONTROL</p> <p>The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).</p>			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
35.00.00	<p>SURGE PROTECTION FOR SOLID STATE EQUIPMENT</p> <p>All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.</p>			
36.00.00	<p>INSTRUMENT AIR SYSTEM</p> <p>The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.</p> <p>Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.</p>			
37.00.00	<p>TAPPING POINTS FOR MEASUREMENTS</p> <p>Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.</p> <p>For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.</p> <p>The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.</p> <ul style="list-style-type: none"> i) Temperature test pockets with stub and thermowell ii) Pressure test pockets 			
38.00.00	<p>SYSTEM DOCUMENTATION</p> <p>The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I</p>			
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<p>38.01.00</p> <p>39.00.00</p>	<p>"Technical Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification.</p> <p>The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.</p> <p>Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.</p> <p>MAINTENANCE MANUALS OF ELECTRONIC MODULES</p> <p>The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.</p>			
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LIST OF CODES AND STANDARDS				
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
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	IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)	
	IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965	
	IS:2825	Code for unfired vessels		
	IS:1520	Horizontal centrifugal pumps for clear cold and fresh water		
	IS:1600	Code for practice for performance of constant speed IC Engines for general purpose		
	IS:1601	Specification for performance of constant speed IC Engines for general Purpose		
	IS:1893	Criteria for earthquake resistant design of structures		
	IS1978-1971	Line Pipe April 1969.	API Standards 5L	
	IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954	
	IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968	
	IS:2312	Propellant type Ventilation fans		
	IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS:3346</p> <p>IS:3354</p> <p>IS:3401</p> <p>IS:3588</p> <p>IS:3589</p> <p>IS:3677</p> <p>IS:3815</p> <p>IS:3895</p> <p>IS:3963</p> <p>IS:3975</p> <p>IS:4503</p>	<p>Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)</p> <p>Outline dimensions for electric lifts.</p> <p>Silica gel</p> <p>Specification for electrical axial flow fans</p> <p>Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diameter)</p> <p>Unbonded rock and slag wool for thermal insulation</p> <p>Point hook with shank for general engineering purposes</p> <p>Specification for monocrystalline semiconductor rectifier cells and stacks</p> <p>Roof extractor unit</p> <p>Mild steel wires, strips and tapes for armouring cables</p> <p>Shell and tube type heat Exchanger</p>	<p>DIN 52612 (Deutscher Normenausschuss)</p> <p>ASTM C 163-1964 (American Society of Testing and materials)</p> <p>ASTM C 167-1974</p> <p>ASTM C 177-1963</p> <p>BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)</p>
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 48 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS:4540</p> <p>IS:4671</p> <p>IS:4736</p> <p>IS:4894</p> <p>IS:5456</p> <p>IS:5749</p> <p>IS:6392</p> <p>IS:6524 Part-I</p> <p>IS:7098</p> <p>IS:7373</p> <p>IS:7938</p> <p>ISO:1217</p> <p>ASHRAE-33 and air heating coils.</p> <p>ASHRAE-52-76</p>	<p>Specification for monory-stallines rectifire assembly equipment</p> <p>Expanded polystyrene for thermal insulation purpose</p> <p>Hot dip zinc coating on steel tubes</p> <p>Centrifugal fans</p> <p>Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)</p> <p>Forged ramshorn hooks</p> <p>Steel pipe flanges</p> <p>Code of practice for design of tower cranes Static and rail mounted</p> <p>Cross linked Polyethylene insulated PVC sheathed cables</p> <p>Specification for wrought aluminium and aluminium sheet and strips</p> <p>Air receivers for compressed air installation</p> <p>Displacement compressor-Acceptance test</p> <p>Methods of testing for rating of forced circulation air cooling</p> <p>Air cleaning device used in general ventilation for removing particle matter.</p>	<p>Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958</p> <p>BS 4504 : 1969</p> <p>BS 2799 : 1956</p> <p>Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524</p>
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 49 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>ASHRAE-22-72</p> <p>ASHRAE 23-67</p> <p>ARI-450-6</p> <p>ARI-550</p> <p>ARI-410</p> <p>ARI-430/435 BS:848 (Part-1,2)</p> <p>BS:400</p> <p>BS:401</p> <p>CTI Code ACT-105</p> <p>ANSI-31.5</p> <p>ASME-PTC- 23-1958</p> <p>AMCA A-21C</p> <p>API:618</p> <p>HYDRAULIC INSTITUTE STANDARDS.</p> <p>HYDRANT SYSTEM MANUALS OF TAC.</p> <p>TAC MANUALS OF SPRAY SYSTEM</p> <p>NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.</p> <p>INDIAN EXPLOSIVES ACT.</p> <p>INDIAN FACTORIES ACT.</p> <p>STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.</p>	<p>Method of testing for rating of water cooled refrigerant condensers.</p> <p>Methods of testing for rating of positive displacement refrigerant compressors.</p> <p>Standard for water cooled refrigerant condensers.</p> <p>Standard for centrifugal water chilling packages.</p> <p>Standard for forced circulation air cooling and air heating coils</p> <p>Central station AHU/Application of Central Station AHU Fans</p> <p>Low carbon steel cylinders for the storage & transport of permanent gases.</p> <p>Low carbon steel cylinders for the storage & transport of liquified gases.</p> <p>Acceptance test code for Water Cooling Tower.</p> <p>Refrigerant piping</p> <p>Atmospheric Water Cooling Equipment</p> <p>Test Code for air moving devices</p> <p>Reciprocating Compressor for general refinery services.</p>	
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 50 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>CODE AND STANDARD FOR CIVIL WORKS</p> <p>Some of the applicable Standards, Codes and references are as follows:</p> <p>Excavation & Filling</p> <p>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.</p> <p>IS: 4701 Code of practice for earth work on canals.</p> <p>IS: 9758 Guide lines for Dewatering during construction.</p> <p>IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.</p> <p>Properties, Storage and Handling of Common Building Materials</p> <p>IS: 269 Specification for ordinary Portland cement, 33 grade.</p> <p>IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.</p> <p>IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.</p> <p>IS: 455 Specification for Portland slag cement.</p> <p>IS: 702 Specification for Industrial bitumen.</p> <p>IS: 712 Specification for building limes.</p> <p>IS: 808 Rolled steel Beam channel and angle sections.</p> <p>IS: 1077 Specification for common burnt clay building bricks.</p> <p>IS: 1161 Specification of steel tubes for structural purposes.</p> <p>IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.</p> <p>IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.</p> <p>IS: 1367 Technical supply conditions for Threaded fasteners.</p> <p>IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 51 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	(Part-II) IS: 1542 IS: 1566 IS: 1786 IS: 2062 IS: 2116 IS: 2386 (Parts-I to VIII) IS: 3150 IS: 3495 (Parts-I to IV) IS: 3812 IS: 4031 IS: 4032 IS: 4082 IS: 8112 IS: 8500 IS: 12269 IS: 12894 Cast-In-Situ Concrete and Allied Works IS: 280 IS: 456	Calcined clay based. Specification for sand for plaster. Specification for hard-drawn steel wire fabric for concrete reinforcement. Specification for high strength deformed bars for concrete reinforcement. Specification for steel for general structural purposes. Specification for sand for masonry mortars. Testing of aggregates for concrete. Hexagonal wire netting for general purpose. Methods of tests of burnt clay building bricks. Specification for fly ash, for use as pozzolana and admixture. Methods of physical tests for hydraulic cement. Methods of chemical analysis of hydraulic cement. Recommendations on stacking and storage of construction materials at site. Specification for 43 grade ordinary portland cement. Medium and high strength structural steel. 53 grade ordinary portland cement. Specification for Fly ash lime bricks. Specification for mild steel wire for general engineering purposes. Code of practice for plain and reinforced concrete.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 52 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS: 457</p> <p>IS: 516</p> <p>IS: 650</p> <p>IS: 1199</p> <p>IS: 1791</p> <p>IS: 1838 (Part-I)</p> <p>IS: 2204</p> <p>IS: 2210</p> <p>IS: 2438</p> <p>IS: 2502</p> <p>IS: 2505</p> <p>IS: 2506</p> <p>IS: 2514</p> <p>IS: 2645</p> <p>IS: 2722</p> <p>IS: 2750</p> <p>IS: 2751</p> <p>IS: 3025</p> <p>IS: 3366</p> <p>IS: 3370</p>	<p>Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.</p> <p>Method of test for strength of concrete.</p> <p>Specification for standard sand for testing of cement.</p> <p>Methods of sampling and analysis of concrete.</p> <p>General requirements for batch type concrete mixers.</p> <p>Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).</p> <p>Code of practice for construction of reinforced concrete shell roof.</p> <p>Criteria for the design of reinforced concrete shell structures and folded plates.</p> <p>Specification for roller pan mixer.</p> <p>Code of practice for bending and fixing of bars for concrete reinforcement.</p> <p>General requirements for concrete vibrators, immersion type.</p> <p>General requirements for concrete vibrators, screed board type.</p> <p>Specification for concrete vibrating tables.</p> <p>Specification for Integral cement water proofing compounds.</p> <p>Specification for portable swing weigh batches for concrete. (single and double bucket type)</p> <p>Specification for Steel scaffolding.</p> <p>Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.</p> <p>Methods of sampling and test waste water.</p> <p>Specification for Pan vibrators.</p> <p>Code of practice for concrete structures for the storage of</p>	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 53 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 54 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS: 9417</p> <p>IS: 10262</p> <p>IS: 11384</p> <p>IS: 11504</p> <p>IS: 12118</p> <p>IS: 12200</p> <p>IS: 13311</p> <p>Part-1</p> <p>Part-2</p> <p>SP:23</p> <p>SP: 24</p> <p>SP: 34</p> <p>Precast Concrete Works</p> <p>SP: 7(PartVI/</p> <p>IS: 10297</p> <p>IS: 10505</p> <p>Masonry and Allied Works</p> <p>IS: 1905</p> <p>IS: 2212</p>	<p>Recommendations for welding cold worked steel bars for reinforced concrete construction.</p> <p>Recommended guidelines for concrete mix design.</p> <p>Code of practice for composite construction in structural steel and concrete.</p> <p>Criteria for structural design of reinforced concrete natural draught cooling towers.</p> <p>Specification for two-parts poly sulphide.</p> <p>Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.</p> <p>Method of non-destructive testing of concrete.</p> <p>Ultrasonic pulse velocity.</p> <p>Rebound hammer.</p> <p>Handbook of concrete mixes</p> <p>Explanatory Handbook on IS: 456-1978</p> <p>Handbook on concrete reinforcement and detailing.</p> <p>National Building Code- Structural design of prefabrication and Sec.7) systems building.</p> <p>Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.</p> <p>Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.</p> <p>Code of Practice for Structural Safety of Buildings-Masonry walls.</p> <p>Code of Practice for Brickwork.</p>	
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 55 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS: 2250 SP: 20	Code of Practice for Preparation and use of Masonry Mortar. Explanatory hand book on masonry code.	
	Sheeting Works		
	IS:277	Galvanised steel sheets (plain or corrugated).	
	IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.	
	IS: 513	Cold-rolled carbon steel sheets.	
	IS: 730	Specification for fixing accessories for corrugated sheet roofing.	
	IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.	
	IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.	
	IS: 3007	Code of practice for laying of asbestos cement sheets.	
	IS: 5913	Methods of test for asbestos cement products.	
	IS: 7178	Technical supply conditions for tapping screw.	
	IS: 8183	Bonded mineral wool.	
	IS: 8869	Washers for corrugated sheet roofing.	
	IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.	
	IS: 12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).	
	IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.	
	Fabrication and Erection of Structural Steel Work		
	IS: 2016	Specification for plain washers.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 56 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS: 814</p> <p>IS: 1852</p> <p>IS: 3502</p> <p>IS: 6911</p> <p>IS: 3757</p> <p>IS: 6623</p> <p>IS: 6649</p> <p>IS: 800</p> <p>IS: 816</p> <p>IS: 4000</p> <p>IS: 9595</p> <p>IS: 817</p> <p>IS: 1811</p> <p>IS: 9178</p> <p>IS: 9006</p> <p>IS: 7215</p> <p>IS: 12843</p> <p>IS: 4353</p> <p>SP: 6 (Part 1 to 7)</p>	<p>Specification for covered Electrodes for Metal Arc Welding for weld steel.</p> <p>Specification for Rolling and Cutting Tolerances for Hot rolled steel products.</p> <p>Specifications for chequered plate.</p> <p>Specification for stainless steel plate, sheet and strip.</p> <p>Specification for high strength structural bolts</p> <p>Specification for high strength structural nuts.</p> <p>High Tensile friction grip washers.</p> <p>Code of practice for use of structural steel in general building construction.</p> <p>Code of practice for use of Metal Arc Welding for General Construction.</p> <p>Code of practice for assembly of structural joints using high tensile friction grip fasteners.</p> <p>Code of procedure of Manual Metal Arc Welding of Mild Steel.</p> <p>Code of practice for Training and Testing of Metal Arc Welders.</p> <p>Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).</p> <p>Criteria for Design of steel bins for storage of Bulk Materials.</p> <p>Recommended Practice for Welding of Clad Steel.</p> <p>Tolerances for fabrication steel structures.</p> <p>Tolerance for erection of structural steel.</p> <p>Recommendations for submerged arc welding of mild steel and low alloy steels.</p> <p>ISI Hand book for structural Engineers.</p>	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 57 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334 Plastering and Allied Works IS : 1635 IS : 1661 IS : 2333 IS : 2402 IS : 2547 IS : 3150 Acid and Alkali Resistant Lining IS : 158 IS : 412	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds. Code of practice for field slaking of Building lime and preparation of putty. Application of cement and cement lime plaster finishes. Plaster-of-paris. Code of practice for external rendered finishes. Gypsum building plaster. Hexagonal wire netting for general purpose. Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. Specification for expanded metal steel sheets for general purpose.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS : 4441 IS : 4443 IS : 4456 IS : 4457 IS : 4832 IS : 4860 IS : 9510	Code of practice for use of silicate type chemical resistant mortars. Code of practice for use of resin type chemical resistant mortars. Method of test for chemical resistant tiles. (Part I & II) Specification for ceramic unglazed vitreous acid resistant tiles. Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type Specification for acid resistant bricks. Specification for bitumasitc, Acid resisting grade.		
	Water Supply, Drainage and Sanitation			
	IS : 458 IS : 554 IS : 651 IS : 774 IS : 775 IS : 778 IS : 781 IS : 782 IS : 783	Specification for concrete pipes. Dimensions for pipe threads, where pressure tight joints are made on thread. Specification for salt glazed stoneware pipes. Flushing cisterns for water closets and urinals. Cast iron brackets and supports for wash basins and sinks. Copper alloy gate, globe and check valves for water works purposes. Cast copper alloy screw down bib taps and stop valves for water services. Caulking lead. Code of practice for laying of concrete pipes.		
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 83	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS : 1172</p> <p>IS : 1230</p> <p>IS : 1239</p> <p>IS : 1536</p> <p>IS : 1537</p> <p>IS : 1538</p> <p>IS : 1703</p> <p>IS : 1726</p> <p>IS : 1729</p> <p>IS : 1742</p> <p>IS : 1795</p> <p>IS : 1879</p> <p>IS : 2064</p> <p>IS : 2065</p> <p>IS : 2326</p> <p>IS : 2470 (Part-I & II)</p> <p>IS : 2501</p> <p>IS : 2548</p> <p>IS : 2556 (Part 1 to 15)</p> <p>IS : 2963</p>	<p>Basic requirements for water supply, drainage and sanitation.</p> <p>Cast iron rain water pipes and fittings.</p> <p>Mild steel tubes, tubulars and other wrought steel fittings.</p> <p>Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.</p> <p>Vertically cast iron pressure pipes for water, gas and sewage.</p> <p>Cast iron fittings for pressure pipe for water, gas and sewage.</p> <p>Ball valves (horizontal plunger type) including float for water supply purposes.</p> <p>Cast iron manhole covers and frames.</p> <p>Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.</p> <p>Code of practice for building drainage.</p> <p>Pillar taps for water supply purposes.</p> <p>Malleable cast iron pipe fittings.</p> <p>Code of practice for selection, installation and maintenance of sanitary appliances.</p> <p>Code of practice for water supply in building.</p> <p>Automatic flushing cisterns for urinals.</p> <p>Code of practice for installation of septic tanks.</p> <p>Copper tubes for general engineering purposes.</p> <p>Plastic seat and cover for water-closets.</p> <p>Vitreous sanitary appliances (vitreous china).</p> <p>Non-ferrous waste fittings for wash basins and sinks.</p>	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 60 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS : 3114</p> <p>IS : 3311</p> <p>IS : 3438</p> <p>IS : 3486</p> <p>IS : 3589</p> <p>IS : 3989</p> <p>IS : 4111 (Part I to IV)</p> <p>IS : 4127</p> <p>IS : 4764</p> <p>IS : 4827</p> <p>IS : 5329</p> <p>IS : 5382</p> <p>IS : 5822</p> <p>IS : 5961</p> <p>IS : 7740</p> <p>IS : 8931</p> <p>IS : 8934</p> <p>IS : 9762</p> <p>IS : 10446</p>	<p>Code of practice for laying of cast iron pipes.</p> <p>Waste plug and its accessories for sinks and wash basins.</p> <p>Silvered glass mirrors for general purposes.</p> <p>Cast iron spigot and socket drain pipes.</p> <p>Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).</p> <p>Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.</p> <p>Code of practice for ancillary structure in sewerage system.</p> <p>Code of practice for laying of glazed stone-ware pipes.</p> <p>Tolerance limits for sewage effluents discharged into inland-surface waters.</p> <p>Electro plated coating of nickel and chromium on copper and copper alloys.</p> <p>Code of practice for sanitary pipe work above ground for buildings.</p> <p>Rubber sealing rings for gas mains, water mains and sewers.</p> <p>Code of practice for laying of welded steel pipes for water supply.</p> <p>Cast iron grating for drainage purpose.</p> <p>Code of practice for road gullies.</p> <p>Cast copper alloy fancy bib taps and stop valves for water services.</p> <p>Cast copper alloy fancy pillar taps for water services.</p> <p>Polyethylene floats for ball valves.</p> <p>Glossary of terms for water supply and sanitation.</p>	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 61 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IS : 10592</p> <p>IS : 12592</p> <p>IS : 12701</p> <p>SP: 35</p> <p>-</p> <p>Doors, Windows and Allied Works</p> <p>IS : 204</p> <p>Part-I</p> <p>Part-II</p> <p>IS : 208</p> <p>IS : 281</p> <p>IS : 362</p> <p>IS : 420</p> <p>IS : 1003 Part-I door</p> <p>IS : 1038</p> <p>IS : 1081</p> <p>IS : 1341</p> <p>IS : 1361</p> <p>IS : 1823</p> <p>IS : 1868</p> <p>IS : 2202 (Part-II)</p>	<p>Industrial emergency showers, eye and face fountains and combination units.</p> <p>Specification for precast concrete manhole covers and frames.</p> <p>Rotational moulded polyethylene water storage tanks.</p> <p>Hand book on water supply and drainage.</p> <p>Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.</p> <p>Tower Bolts</p> <p>Ferrous metals.</p> <p>Nonferrous metals.</p> <p>Door Handles.</p> <p>Mild steel sliding door bolts for use with padlocks.</p> <p>Parliament Hinges.</p> <p>Specification for putty, for use on metal frames.</p> <p>Specification for timber panelled and glazed shutters- (Part-I) shutters.</p> <p>Steel doors, windows and ventilators.</p> <p>Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.</p> <p>Steel butt hinges.</p> <p>Steel windows for industrial buildings.</p> <p>Floor door stoppers.</p> <p>Anodic coatings on Aluminium and its alloys.</p> <p>Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels</p>	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 62 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS:2209 IS:2553 IS:2835 IS:3548 IS:3564 IS : 3614 IS:4351 IS:5187 IS:5437 IS:6248 IS:6315 IS:7196 IS:7452 IS:10019 IS:10451 IS:10521 R oof Water Proofing and AlliedWorks IS:1203 IS:1322 IS:1346 IS:1580	Mortice locks (vertical type). Safety glass Flat transparent sheet glass. Code of practice for glazing in buildings. Door closers (Hydraulically regulated). Fire check doors; plate, metal covered and rolling type. Steel door frames. Flush bolts. Wired and figured glass Metal rolling shutters and rolling grills. Floor springs (hydraulically regulated) for heavy doors. Hold fasts. Hot rolled steel sections for doors, windows and ventilators. Mild steel stays and fasteners. Steel sliding shutters (top hung type). Collapsible gates. Methods of testing tar and bitumen. Specification for bitumen felts for water proofing and damp proofing. Code of practice for water proofing of roofs with bitumen felts. Specification for bituminous compound for water proofing and caulking purposes.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 63 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.	
	IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.	
	Floor Finishes and Allied Works		
	IS:1237	Specification for cement concrete flooring tiles.	
	IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.	
	IS:2114	Code of practice for laying in-situ terrazzo floor finish.	
	IS:2571	Code of practice for laying in-situ cement concrete flooring.	
	IS:3462	Specification for unbacked flexible PVC flooring.	
	IS:4971	Recommendations for selection of industrial floor finishes.	
	IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.	
	IS:8042	Specification for white portland cement.	
	IS:13801	Specification for chequered cement concrete flooring tiles.	
	Painting and Allied Works		
	IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.	
	IS:1477	Code of practice for painting of ferrous metals in buildings.	
	Part-I	Pretreatment.	
	Part-II	Painting.	
	IS:1650	Specification for colours for building and decorative finishes.	
	IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.	
	IS:2338	Code of practice for finishing of wood and wood based materials.	
	Part-I	Operations and workmanship	
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 64 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	Part-II IS:2395 Part-I Part-II IS:2524 Part-I Part-II IS:2932 IS:2933 IS:4759 IS:5410 IS:5411 (Part-I) IS:6278 IS:10403 Piling and Foundation IS:1080 IS:1904 IS:2911 IS:2950 IS:2974 (Part-I TO V) IS:6403	Schedules Code of practice for painting concrete, masonry and plaster surfaces. Operations and workmanship. Schedule. Code of practice for painting of nonferrous metals in buildings. Pretreatment. Painting. Specification of synthetic enamel paint, exterior, under-coating and finishing. Specification enamel paint, under coating and finishing. Code of practice for hot dip zinc coating on structural steel and other allied products. Specification for cement paint Specification for plastic emulsion paint-for exterior use Code of practices for white washing and colour washing. Glossary of terms relating to building finishes. Code of practice for design and construction of simple spread foundations. Code of practice for design and construction of foundations in Soils; General Requirements. Code of practice for designs and construction of Pile foundations (Relevant Parts). Code of practice for designs and construction of Raft (Part-I) foundation. Code of practice for design and construction of machine foundations. Code of practice for determination of Allowable Bearing pressure on Shallow foundation.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 65 OF 83


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>IS:8009</p> <p>Part-I</p> <p>Part-II</p> <p>IS:12070</p> <p>DIN:4024</p> <p>VDI:2056</p> <p>VDI:2060</p> <p>Stop Log and Trash Rack</p> <p>IS:4622</p> <p>IS:5620</p> <p>IS:11388</p> <p>IS:11855</p> <p>Roads</p> <p>IRC:5</p> <p>IRC:14</p> <p>IRC:16</p> <p>IRC:19</p> <p>IRC:21</p> <p>IRC:34</p> <p>IRC:36</p> <p>IRC:37</p> <p>IRC:56</p> <p>IRC:73</p> <p>IRC:86</p>	<p>Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.</p> <p>Shallow foundations.</p> <p>Deep foundations.</p> <p>Code of practice for design and construction of shallow foundations on rocks.</p> <p>Flexible supporting structures for machines with rotating machines.</p> <p>Criteria for assessing mechanical vibrations of machines.</p> <p>Criteria for assessing rotating imbalances in machines.</p> <p>Recommendations for fixed - wheel gates structural design.</p> <p>Recommendations for structural design criteria for low head slide gates.</p> <p>Recommendations for design of trash rack for intakes.</p> <p>General requirements for rubber seals for hydraulic gates.</p> <p>Standard specifications and Code of practice for road bridges, section-I general Features of Design.</p> <p>Recommended practice of 2cm thick bitumen and tar carpets.</p> <p>Specification for priming of base course with bituminous primers.</p> <p>Standard specifications and code of practice for water bound macadam.</p> <p>Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).</p> <p>Recommendations for road construction in waterlogged areas.</p> <p>Recommended practice for the construction of earth embankments for road works.</p> <p>Guidelines for the Design of flexible pavements.</p> <p>Recommended practice for treatment of embankment slopes for erosion control.</p> <p>Geometric design standards for rural (non-urban) highways.</p> <p>Geometric Design standards for urban roads in plains.</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 66 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	<p>IRC:SP:13</p> <p>IRC - Public- ation</p> <p>IS:73</p> <p>Loadings</p> <p>IS:875 (Pt. I to V)</p> <p>IS:1893</p> <p>IS:4091</p> <p>IRC:6</p> <p>M.O.T.</p> <p>Safety</p> <p>IS:3696 (Part I & II)</p> <p>IS:3764</p> <p>IS:4081</p> <p>IS:4130</p> <p>IS:5121</p> <p>IS:5916</p> <p>IS:7205</p> <p>IS:7293</p> <p>IS:7969</p> <p>IS:11769</p> <p>- Indian Explosives Act. 1940 as updated.</p> <p>Architectural design of buildings</p> <p>SP:7</p> <p>SP:41</p>	<p>Guidelines for the design of small bridges & culverts.</p> <p>Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.</p> <p>Specification for paving bitumen</p> <p>Code of practice for design loads other than earthquake) for buildings and structures.</p> <p>Criteria for earthquake resistant design of structures.</p> <p>Code of Practice for design and construction of foundation for transmission line towers & poles.</p> <p>Standard specifications & code of practice for road bridges, Section-II Loads and stresses.</p> <p>Deptt. of railways Bridge Rules.</p> <p>Safety code for scaffolds and ladders.</p> <p>Safety code for excavation work.</p> <p>Safety code for blasting and related drilling operations.</p> <p>Safety code for demolition of buildings.</p> <p>Safety code for piling and other deep foundations.</p> <p>Safety code for construction involving use of hot bituminous materials.</p> <p>Safety code for erection on structural steelwork.</p> <p>Safety code for working with construction machinery.</p> <p>Safety code for handling and storage of building materials</p> <p>Guidelines for safe use of products containing asbestos.</p> <p>Hand book on functional requirements of buildings (other than industrial buildings)</p>	
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 67 OF 83</p>


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>Miscellaneous</p> <p>IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers.</p> <p>IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.</p> <p>IS:10430 Creteria for design of lined canals and liner for selection of type of lining.</p> <p>IS:11592 Code of practice for selection and design of belt conveyors.</p> <p>IS:12867 PVC handrails covers.</p> <p>CIRIA Design and construction of buried thin-wall pipes.</p> <p>Publication</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 68 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION</p> <p>The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.</p> <p>Temperature Measurements</p> <ol style="list-style-type: none"> 1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). 2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. 3. Temperature measurement by electrical Resistance thermometers - IS:2806. 4. Thermometer - element - Platinum resistance - IS:2848. <p>Pressure Measurements</p> <ol style="list-style-type: none"> 1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). <li style="padding-left: 20px;">b) Electronic transmitters BS:6447. 2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. 3. Process operated switch devices (Pr. Switch) BS-6134. <p>Flow Measurements</p> <p>Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.</p> <p>Measurement of fluid flow in closed conduits - BS-1042.</p> <p>Electronic Measuring Instrument & Control Hardware/ Software</p> <ol style="list-style-type: none"> 1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. 2. Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. 3. Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. 			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 69 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<ol style="list-style-type: none"> 4. Dynamic response testing of process control instrumentation ISA - S 26 (1968). 5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. 6. Printed circuit boards - IPC TM - 650, IEC 326 C. 7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. 8. Edge socket connectors - IEC 130-11. 9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. 10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). 11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R). 12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. 13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. 14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. 15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988. 16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 70 OF 83</p>	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.</p> <p>Instrument Switches and Contact</p> <p>1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.</p> <p>2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.</p> <p>Enclosures</p> <p>1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).</p> <p>2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).</p> <p>3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.</p> <p>Apparatus, enclosures and installation practices in hazardous area</p> <p>1. Classification of hazardous area - NFPA 70 - 1984, Article 500.</p> <p>2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.</p> <p>3. Intrinsically safe apparatus - NFPA 493 1978.</p> <p>4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.</p> <p>5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.</p> <p>Sampling System</p> <p>1. Stainless steel material of tubing and valves for sampling system - ASTM 296-82, Grade 7 P 316.</p> <p>2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.</p> <p>3. Water and steam in power cycle - ASME PTC 19.11.</p> <p>4. Standard methods of sampling system - ASTM D 1066-99.</p> <p>Annunciators</p> <p>1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 71 OF 83</p>	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472</p> <p>3. Damp heat cycling test - IS:2106</p> <p>4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78</p> <p>Protections</p> <p>1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.</p> <p>2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.</p> <p>3. Turbine water damage prevention - ASME TDP-1-1980.</p> <p>4. Boiler safety interlocks - NFPA 85 - 2011 or latest version.</p> <p>UPS System</p> <p>1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.</p> <p>2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.</p> <p>3. Surge withstand capability test - ANSI C 37.90 1 -1989.</p> <p>4. Performance testing of UPS - IEC 146.</p> <p>5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.</p> <p>6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.</p> <p>7. Printed Circuit Board - IPC TM 650, IEC 326C.</p> <p>8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.</p> <p>Control Valves</p> <p>1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.</p> <p>2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.</p> <p>3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).</p> <p>4. Codes for pressure piping - ANSI B 31.1</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 72 OF 83</p>	


CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>5. Control Valve leak class - ISA RP 39.6</p> <p>Process Connection & Piping</p> <ol style="list-style-type: none"> 1. Codes for pressure piping "power piping" - ANSI B 31.1. 2. Seamless carbon steel pipe ASTM - A - 106. 3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. 4. Material for socket welded fittings - ASTM - A - 105. 5. Seamless ferritic alloy steep pipe - ASTM - A - 335. 6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. 7. Composition bronze of ounce metal castings - ASTM - B - 62. 8. Seamless Copper tube, bright annealed - ASTM - B - 168. 9. Seamless copper tube - ASTM - B - 75. 10. Dimension of fittings - ANSI - B - 16.11. 11. Valves flanged and butt welding ends - ANSI - B - 16.34. <p>Instrument Tubing</p> <ol style="list-style-type: none"> 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11. 4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. <p>Cables</p> <ol style="list-style-type: none"> 1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. 2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. 3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions through 2/83. 4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). 5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. 6. Rules for Testing insulated cables and flexible cables : VVDE - 0472 			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 73 OF 83</p>	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)</p> <p>8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.</p> <p>9. Oxygen index and temperature index test - ASTM D - 2863.</p> <p>10. Smoke density measurement test - ASTMD - 2843.</p> <p>11. Acid gas generation test - IEC - 754 - 1.</p> <p>12. Swedish Chimney test - SEN - 4241475 (F3).</p> <p>13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.</p> <p>14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.</p> <p>15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).</p> <p>Cable Trays, Conduits</p> <p>1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.</p> <p>2. -do- Test Standards. NEMA VE-1-1979.</p> <p>3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.</p> <p>Public Address System</p> <p>1. Specifications for loud speakers - IS:7741 (Part-I, II and III)</p> <p>2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301</p> <p>3. Specification for Public Address Amplifiers - IS:10426.</p> <p>4. Code of practice for outdoor installation of PA system - IS:1982.</p> <p>5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.</p> <p>6. Basic environmental testing procedures for electronic and electrical items - IS:9000.</p> <p>7. Characteristics and methods of measurements for sound system equipment - IS:9302</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p align="center">PAGE 74 OF 83</p>	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	<p>8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732</p> <p>9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)</p> <p>10. Fittings for rigid steel conduits for electrical wiring - IS:2667</p> <p>11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.</p> <p>Vibration Monitoring System</p> <p>1. API 670 - 1994</p> <p>2. BS : 4675 Part-2</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>PART-C GENERAL TECHNICAL REQUIREMENTS</p>	<p>PAGE 75 OF 83</p>	

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

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

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

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


1/1

ENGG. DIV./QA&I

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 76 OF 83
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SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV. NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	 FOR NTPC USE		DOC. NO.:	REV.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					REVIEWED BY	APPROVED BY


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

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ENGG. DIV./QA&I

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 77 OF 83
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ANNEXURE-III


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

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

LEGENDS
SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.
DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.
NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”
QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.
CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.
UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 83
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ANNEXURE-IV

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

LOT-3 PROJECTS STEAM GENERATOR ISLAND PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(3)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 79 OF 83
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ANNEXURE-V

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks	
											Temp.	Holding time		Spec. No.	ACC Norm Ref.		

NOTES:

SIGNATURE

FORMAT 1/1 Engg. Div. / QA&I

LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(3)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 80 OF 83
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CLAUSE NO.

GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)




S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			
	First submission and submission with major changes			
	▪ Layout (A0&A1 sizes)	4	-	
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-	
	▪ P&ID (All sizes)	4	-	
	a) Final drawings/documents (Directly to site)	6	2	
	b) "As Built" Drawing/Documents (Directly to site)	6	2	
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2	
2	Erection Manual (Directly to site)	4 sets	2	
3	Operation & Maintenance manual	1 set		--
	i) First Submission			
	ii) Final Submission (Directly to site)	4 sets	2	
4	Plant Hand Book	1		1
	i) First Submission			
5	Commissioning and Performance Test Procedure manual	1 set		--
	i) First Submission			
	ii) Final Submission (Directly to site)	4 sets	2	

LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION – VI
BID DOC. NO.:CS-0011-109(3)-9

PART-C
GENERAL TECHNICAL
REQUIREMENTS
Annexure-VI

PAGE
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			
	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--	
	ii) Approved Copies (Direct to Site)	4 sets	2	
7	Project Completion Report (Directly to site)	6 sets	2	
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--	
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--	
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	--	
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2	
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	--	
	ii) Approved copies (Direct to Site)	4 sets	2	
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2	
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-C GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 82 OF 83	

CLAUSE NO.

GENERAL TECHNICAL REQUIREMENTS

ANNEXURE-VII

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
FGD Layout & model of FGD area, cable & piping trestles etc. FGD <ul style="list-style-type: none"> • Mass balance, Design, selection and sizing calculations of FGD • Training on factors affecting sizing/ efficiency of FGD system, equipments & auxiliaries • Materials for FGD & selection • Basic concepts, Design and sizing calculations on slurry systems including piping, valves, etc.. • FGD electrical system • FGD control system Erection strategies, erection procedures Performance as per applicable code and demonstration tests.	Familiarization with various system and equipment Performance, data collection analysis and review O&M feed back Operation history of various equipments and system Failure analysis	Manufacturing process of Absorber and equipments Welding process Testing facilities Product development in process Future plan for technology induction R&D work in progress	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues. Familiarization of special maintenance techniques Special tool and tackles familiarization	
MANMONTH	2	0.5	0.5	6

**LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION – VI
BID DOC. NO.:CS-0011-109(3)-9**

**PART-C
GENERAL TECHNICAL
REQUIREMENTS
ANNEXURE-VII**


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SUB-SECTION-VI


FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES


**LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(3)-9**

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
<p>1.00.00</p> <p>GENERAL</p> <p>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)”.</p> <p>2.00.00</p> <p>PERFORMANCE GUARANTEES / PERFORMANCE TESTS</p> <p>2.01.00</p> <p>General Requirements</p> <p>2.01.01</p> <p>2.01.02</p> <p>2.01.03</p> <p>2.01.04</p> <p>2.01.05</p> <p>2.01.06</p>	<p>FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS</p> <p>GENERAL</p> <p>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)”.</p> <p>PERFORMANCE GUARANTEES / PERFORMANCE TESTS</p> <p>General Requirements</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>2.01.06 It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 1 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
2.02.00	Test Instrumentation, Flow Measurement and their Calibration			
2.02.01	<p>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.</p> <p>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.</p> <p>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.</p>			
2.02.02	<p>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.</p>			
2.02.03	<p>The Contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following:</p> <ul style="list-style-type: none"> (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. 			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p align="center">PAGE 2 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
<p>2.03.00</p> <p>2.03.01</p> <p>2.04.00</p>	<p>(h) Scheme showing measurement points.</p> <p>(i) Sample calculation.</p> <p>(j) Acceptance criteria.</p> <p>(k) Any other information required for conducting the test.</p> <p>Test Reports</p> <p>After the conductance of Performance test, the Contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Employer after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Employer for approval.</p> <p>Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed specifications.</p> <p>Acceptance of Guarantee Test Results</p> <p>(i) For Category-I Guarantees</p> <p>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 but are achieved within the Acceptable Shortfall Limit as specified at clause 3.00.00 of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 3.00.00 of this sub-section. However, if, the demonstrated performance guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, 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:</p> <p>Reject the equipment / system / plant and recover from the Contractor the payments already made</p> <p style="text-align: center;">OR</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 3 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
3.00.00	<p>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.</p> <p>(ii) For Category-II Guarantees</p> <p>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:</p> <p>Reject the equipment /system / plant and recover from the Contractor the payments already made.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p>AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT</p> <p>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.</p>			
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p style="text-align: center;">SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p style="text-align: center;">PAGE 4 OF 30</p>	

CLAUSE NO.

FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES



RAMAGUNDAM (3X500 MW)

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 2,451,908 /- (INR Two Million Four Hundred Fifty One Thousand Nine Hundred Eight only) for every 0.1% point shortfall in SO₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO₂ removal efficiency.
ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 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 249,478 /- (INR Two Hundred Forty Nine Thousand Four Hundred Seventy Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

CLAUSE NO.

FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES



RAMAGUNDAM St-II (3X200 MW) Common FGD system


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 3,633,561/- (INR Three Million Six Hundred Thirty Three Thousand Five Hundred Sixty One 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 249,478 /- (INR Two Hundred Forty Nine Thousand Four Hundred Seventy Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption


LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM
PACKAGE


TECHNICAL SPECIFICATION
SECTION – VI, PART-A
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SUB-SECTION-VI
FUNCTIONAL
GUARANTEES &
LIQUIDATED DAMAGES


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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
<p>4.00.00</p> <p>4.01.00</p>	<p>NOTES APPLICABLE FOR EACH PROJECT:</p> <ul style="list-style-type: none"> 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 <p>GUARANTEES PARAMETERS</p> <p>Guarantees Under Category-I</p> <p>The Performance Guarantees which attract Liquidated Damages (LD) are as follows:</p> <p>The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI:</p> <ul style="list-style-type: none"> (i) SO₂ removal Efficiency (ii) Limestone Consumption (iii) Auxiliary Power Consumption <p>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</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 21 OF 30</p>	


CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
4.02.00	<p>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.</p> <p>Guarantees Under Category-II</p> <p>The parameters/capabilities shall be demonstrated for various systems/ equipments shall include but not limited to the following:-</p> <p>(i) Wet ball Mill capacity at rated fineness</p> <p>The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions:</p> <p>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)</p> <p>ii) Limestone Quality : All available quality from the specified range.</p> <p>(ii) Wet ball Mill wear parts guarantee</p> <p>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.</p> <p>(iii) Wet ball Mill ball consumption</p> <p>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.</p> <p>(iv) Vacuum Belt Filter Capacity</p> <p>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.</p>			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 22 OF 30	


CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>(v) Gypsum Purity</p> <p>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.</p> <p>(vi) NOT USED</p> <p>(vii) Performance characteristics of fans (capacity, head developed, etc.).</p> <p>(viii) Margins on fans in case Booster Fan is provided by the Contractor.</p> <p>Booster Fans - As specified in Part B of Technical Specifications</p> <p>(ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.</p> <p>(x) Noise</p> <p>All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications.</p> <p>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.</p> <p>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.</p> <p>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.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 23 OF 30</p>	


CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>(xi) Mist Outlet Droplet Content</p> <p>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.</p> <p>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.</p> <p>(xii) Availability of FGD Plant</p> <p>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</p> <p>(xiii) Air Conditioning System</p> <p>A. Following shall be demonstrated at Shop</p> <p>1) Capacity and static pressure of AHU fans at its rated duty point.</p> <p>B. Following shall be demonstrated at Site</p> <p>1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building.</p> <p>2) Guaranteed room conditions during summer for all the Air conditioned areas.</p> <p>3) Vibration and noise level of condensing units & centrifugal fans of AHUs.</p> <p>(xiv) Ventilation System</p> <p>A. Following shall be demonstrated at Shop</p> <p>1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.</p> <p>2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.</p> <p>B. Following shall be demonstrated at Site</p> <p>1) Vibration & Noise level of centrifugal fans & pumps of UAF units.</p> <p>(xv) Compressed Air System</p> <p>a) Following shall be demonstrated at shop:</p> <p>i) Capacity and discharge pressure of each air compressor.</p> <p>b) Following shall be demonstrated at site:</p> <p>ii) Dew point of air at the outlet of air drying plants of air compressor.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 24 OF 30</p>	


CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES 		
5.00.00	<p>iv) Pressure drop across air drying plant .</p> <p>v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable)</p> <p>(xvi) Equipment Cooling Water System</p> <p>i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site.</p> <p>ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.</p> <p>(xvii) Limestone Handling System and Gypsum Handling System</p> <p>a) Limestone Handling Plant</p> <p>(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.</p> <p>(ii) Bidder shall also demonstrate the guaranteed tipping rate of truck tipplers.</p> <p>b) Gypsum Handling Plant</p> <p>The Bidder shall demonstrate the guaranteed conveying from belt filter to storage shed/silo including all intermediate equipment & conveyors.</p>		
	<p>AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT</p> <p>The unit auxiliary power consumption shall be calculated using the following relationship.</p> $P_a = (P_{a1} + P_{a2} + \dots + P_{an})/n$ $P_{an} = P_{un} + T_{Ln}$ <p>P_a = Guaranteed Auxiliary Power Consumption</p> <p>P_{an} = Auxiliary Power Consumption for unit # n</p> <p>(Where "n" is the unit number e.g. 1, 2,)</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 25 OF 30</p>

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>P_{un} = Power consumed by the auxiliaries of the unit under test</p> <p>T_{Ln} = Losses of the transformers supplied by bidder based on works test reports</p> <p>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:</p> <ol style="list-style-type: none"> i. Absorber Recirculation Pump(s)/Gas Cooling Pumps ii. Absorber Oxidation Air Blower(s) iii. Absorber Oxidation Tank Agitators iv. Gypsum Bleed Pumps v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project vi. Limestone Slurry Pump(s) vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project viii. Power consumption of all working Booster water pumps (if provided) to ACW pumps after PHE divided by the number of units in the project ix. Power consumption of Clarified water pumps (if provided) and Clarified booster water pumps (if provided) divided by the number of units in the project x. Power consumption of Process water pump(s) divided by the number of units in the project xi. Mist Eliminator Wash Water pump(s) xii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project xiii. Power consumption of total number of DM Cooling (working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system divided by the number of units (working) in the project xiv. Power consumption of total number of Auxiliary Cooling (working) water pump/Permeate water pump to supply cooling water on the secondary side 			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p align="center">PAGE 26 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>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</p> <p>xv. Booster Fans</p> <p>xvi. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project</p> <p>xvii. Power consumption of Filtrate Pump(s) divided by the number of units in the project</p> <p>xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project</p> <p>xix. Power consumption of Hydro-cyclone and Waste Water Pump divided by the number of units in the project</p> <p>xx. Power consumption of all other continuous running Agitators divided by the number of units in the project</p> <p>xxi. Air Conditioning System (*)</p> <p>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</p> <p>xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)</p> <p>(*) 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.)</p> <p>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.</p> <p>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).</p> <p>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).</p> <p>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).</p> <p>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).</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p>PAGE 27 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
6.00.00	<p>xxvii) Air Conditioning System (*)</p> <p>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..</p> <p>xxviii) Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)</p> <p>(*) 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.)</p> <p>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</p> <p>NOTE:</p> <ol style="list-style-type: none"> 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 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. <p>METHOD OF COMPUTING TEST EFFICIENCY OF FGD</p> <p>The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the</p>			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 28 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
7.00.00	<p>test shall, however be mutually agreed upon between the employer and the contractor.</p> <p>METHOD OF COMPUTING AVAILABILITY</p> <p>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.</p> <p>Availability 'A' in %:</p> $A = \frac{T_c \times 100\%}{T_k}$ <p>Tc – recorded time of FGD operation, expressed in hours, Tk – recorded time of boiler operation, expressed in hours,</p> <p>However, it is required that:</p> <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (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. <p>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 should clearly indicate along with their offer.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p align="center">PAGE 29 OF 30</p>	


CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>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.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES</p>	<p align="center">PAGE 30 OF 30</p>	


SUB-SECTION-V-QM4


AIR CONDITIONING & VENTILATION SYSTEM

**LOT-3 PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(3)-9**

CLAUSE NO.	QUALITY ASSURANCE			
AIR CONDITIONING AND VENTILATION SYSTEM FOR FGDS				
CLAUSE NO	QA MODULE FOR AIR CONDITIONING AND VENTILATION SYSTEM			
1.00.00	Air cooled Condensing Unit (Outdoor unit), Evaporating unit (Indoor unit)			
1.01.00	Compressor of Condensing Unit shall be tested as per relevant standard			
1.01.01	Condenser (Heat Exchanger) , Evaporator coils assembly shall be subjected to Hydraulic/Pneumatic pressure/leakage test as applicable and Electronic refrigerant leakage test along with all relevant test on tube as per applicable code..			
1.01.02	Assembled Condensing unit (Outdoor Unit) shall be subjected to Leakage test, Vacuum test, Run test/Functional test as applicable			
2.00.00	FANS			
2.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.			
2.02.00	DPT of fan shafts shall be carried out after machining.			
2.03.00	UT of fan shafts (diameter equal to or above 50mm) shall be carried out.			
2.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3			
2.05.00	All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.			
2.06.00	One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.			
3.00.00	AIR HANDLING UNIT			
3.01.00	For Fans refer tests as mentioned at 2.00.00			
3.02.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.			
3.03.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.			
4.00.00	CENTRIFUGAL PUMP			
4.01.00	UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.			
4.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3			
4.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.			
4.04.00	Standard Running Test			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION–V-QM4 AIR CONDITIONING & VENTILATION SYSTEM	Page 1 of 3	

CLAUSE NO.	QUALITY ASSURANCE			
4.05.01	All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only.			
4.05.02	Noise and vibration shall be measured at shop for reference purpose only.			
4.05.03	Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.			
4.05.04	NPSH test shall be conducted with water as the medium, if required as per approved data sheets.			
5.00.00	LOW PRESSURE AIR DISTRIBUTION SYSTEM			
5.01.00	Functional test for fire damper along with solenoid shall be done.			
5.02.00	Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.			
5.03.00	Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.			
6.00.00	INSULATION			
6.01.00	Insulation material shall be tested for all mandatory tests only as per relevant code/standard.			
6.02.00	Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard.			
7.00.00	AIR FILTERS			
7.01.00	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.			
8.00.00	PIPES & FITTINGS			
8.01.00	All pipes and fittings shall be tested as per applicable codes / standard.			
8.02.00	Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement			
9.00.00	VALVES & SPECIALTIES			
9.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.			
9.02.00	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION–V-QM4 AIR CONDITIONING & VENTILATION SYSTEM	Page 2 of 3	

CLAUSE NO.	QUALITY ASSURANCE			
9.03.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.			
9.04.00	Functional check of the valves for smooth opening and closing shall be done.			
10.00.00	SPLIT/CASSETTE / WINDOW AC/ PAC			
10.01.00	Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.			
10.02.00	PAC Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.			
10.03.00	Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.			
11.00.00	Unitary Air Filter (UAF)			
11.01.00	Random 10% DPT on weld joints shall be carried out			
11.02.00	Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out			
11.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION–V-QM4 AIR CONDITIONING & VENTILATION SYSTEM	Page 3 of 3



3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)

HVAC SYSTEM
PAINTING SPECIFICATIONS

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C 2C

REV. 00

SECTION: I

SUB-SECTION: C 2C

REFER SECTION C2-A



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C-3

REV. 00

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)



**ELECTRICAL EQUIPMENT SPECIFICATION FOR
HVAC SYSTEM**

**Ramagundam (FGD) STPP, Stage-I & II (3x200MW +
3x500 MW)**

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : **10.01.2022**

SHEET : 1 OF 3

**TECHNICAL SPECIFICATION
FOR
HVAC SYSTEM
(ELECTRICAL PORTION)**



**ELECTRICAL EQUIPMENT SPECIFICATION FOR
HVAC SYSTEM
Ramagundam (FGD) STPP, Stage-I & II (3x200MW +
3x500 MW)**

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION :
REV NO. 00 : DATE : 10.02.2022
SHEET : 2 OF 3

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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



**ELECTRICAL EQUIPMENT SPECIFICATION FOR
HVAC SYSTEM**
Ramagundam (FGD) STPP, Stage-I & II (3x200MW +
3x500 MW)

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : 10.01.2022

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compliance certificate/No deviation certificate.

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

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) Specification for Motors
- c) Specification for cable lugs and glands
- d) Quality plan for motors with list of makes
- e) Electrical Load data format
- f) BHEL cable listing format

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: HVAC SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: Ramagundam (FGD) STPP, Stage-I & II (3x200MW +3x500 MW)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGE: HVAC SYSTEM****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: Ramagundam (FGD) STPP, Stage-I & II (3x200MW +3x500 MW)**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

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

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: HVAC SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: Ramagundam (FGD) STPP, Stage-I & II (3x200MW +3x500 MW)

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

SUB-SECTION-II-E2

MOTORS

Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)

TECHNICAL REQUIREMENTS																					
MOTORS																					
1.00.00	GENERAL REQUIREMENTS																				
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.																				
1.02.00	All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.																				
1.03.00	Contactors shall provide fully compatible electrical system, equipment's, accessories and services.																				
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.																				
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.																				
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.																				
1.07.00	Degree of Protection Degree of protection for various enclosures as per IEC60034-05 shall be as follows :- <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">i)</td> <td style="width: 45%;">Indoor motors</td> <td style="width: 10%; text-align: center;">-</td> <td style="width: 40%;">IP 54</td> </tr> <tr> <td>ii)</td> <td>Outdoor motors</td> <td style="text-align: center;">-</td> <td>IP 55</td> </tr> <tr> <td>iii)</td> <td>Cable box-indoor area</td> <td style="text-align: center;">-</td> <td>IP 54</td> </tr> <tr> <td>iv)</td> <td>Cable box-Outdoor area</td> <td style="text-align: center;">-</td> <td>IP 55</td> </tr> </table>	i)	Indoor motors	-	IP 54	ii)	Outdoor motors	-	IP 55	iii)	Cable box-indoor area	-	IP 54	iv)	Cable box-Outdoor area	-	IP 55				
i)	Indoor motors	-	IP 54																		
ii)	Outdoor motors	-	IP 55																		
iii)	Cable box-indoor area	-	IP 54																		
iv)	Cable box-Outdoor area	-	IP 55																		
2.00.00	CODES AND STANDARDS																				
	<table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">1)</td> <td style="width: 45%;">Three phase induction motors</td> <td style="width: 10%; text-align: center;">:</td> <td style="width: 40%;">IS/IEC:60034</td> </tr> <tr> <td>2)</td> <td>Single phase AC motors</td> <td style="text-align: center;">:</td> <td>IS/ IEC:60034</td> </tr> <tr> <td>3)</td> <td>Crane duty motors</td> <td style="text-align: center;">:</td> <td>IS:3177, IS/IEC:60034</td> </tr> <tr> <td>4)</td> <td>DC motors/generators</td> <td style="text-align: center;">:</td> <td>IS:4722, IS/IEC:60034</td> </tr> <tr> <td>5)</td> <td>Energy Efficient motors</td> <td style="text-align: center;">:</td> <td>IS 12615, IEC:60034-30</td> </tr> </table>	1)	Three phase induction motors	:	IS/IEC:60034	2)	Single phase AC motors	:	IS/ IEC:60034	3)	Crane duty motors	:	IS:3177, IS/IEC:60034	4)	DC motors/generators	:	IS:4722, IS/IEC:60034	5)	Energy Efficient motors	:	IS 12615, IEC:60034-30
1)	Three phase induction motors	:	IS/IEC:60034																		
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3)	Crane duty motors	:	IS:3177, IS/IEC:60034																		
4)	DC motors/generators	:	IS:4722, IS/IEC:60034																		
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30																		
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)																					

TECHNICAL REQUIREMENTS	
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	Torque Requirements
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor rated torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.
6.03.00	Starting voltage requirement
	(a) Up to 85% of rated voltage for ratings below 110 KW
	(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
	(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW
	(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW
	(e) Up to 75 % of rated voltage for ratings above 4000KW
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACWA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

TECHNICAL REQUIREMENTS	
7.03.00	<p>(a) Fuel oil area : Group – IIB</p> <p>(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)</p> <p>Winding and Insulation</p> <p>(a) Type : Non-hygroscopic, oil resistant, flame resistant</p> <p>(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.</p> <p>(c) 11kV, 6.6 KV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.</p> <p>(d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better</p>
7.04.00	Motors rated above 1000KW shall have insulated bearings/housing to prevent flow of shaft currents.
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer and minimum 2 numbers duplex platinum resistance type temperature detectors.
7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	3.3/6.6 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Contractor shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

TECHNICAL REQUIREMENTS	
	suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.
7.11.00	The spacing between gland plate & centre of bottom terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):
	(a) From 50KW & upto 110KW : 11.0
	(b) From 110 KW & upto 200 KW : 9.0
	(c) Above 200 KW & upto 1000KW : 10.0
	(d) From 1001KW & upto 4000KW : 9.0
	(e) Above 4000KW : 6 to 6.5
10.00.00	TYPE TEST
10.01.00	HT MOTORS
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

	TECHNICAL REQUIREMENTS
	<p>parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.</p>
10.01.03	<p>In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.</p>
10.01.04	<p>Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p>
10.01.05	<p>LIST OF TYPE TESTS TO BE CONDUCTED</p> <p>The following type tests shall be conducted on each type and rating of HT motor</p> <ul style="list-style-type: none"> (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test(subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

TECHNICAL REQUIREMENTS	
10.01.06	<p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of HT motor</p> <ul style="list-style-type: none"> (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	LT Motors
10.02.01	<p>LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p>
10.02.02	<p>However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p>
10.02.03	<p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only</p> <ul style="list-style-type: none"> 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip 5. Temperature rise test
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

	TECHNICAL REQUIREMENTS
	<ol style="list-style-type: none"> 6. Momentary excess torque test. 7. High voltage test 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section) 10. Test for degree of protection and 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1 <p>10.03.00 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.</p> <p>10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p>
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

TECHNICAL REQUIREMENTS

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of bottom terminal stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	385/203 (For Single core cables only)

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

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

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

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


Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)

Cable glands



Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards


	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
					6	C/ N				9	D	**		
1	2	3	4	5			M	C	N			8		
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V*	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREME NT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V*	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2





		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:

1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.


LEGENDS:

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



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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	 KUNAL GANDHI	KUNAL GANDHI
Reviewed by:	 PRAVEE N DUTTA	PRAVEEN DUTTA	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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Sign & Date	
Seal	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :		
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04		DATE:17.04.2020
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM:		SECTION: II

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


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Reviewed by: PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by: 	R K JAISWAL		

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		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM:	SECTION: II	SHEET 2 OF 9

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


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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUNWAR JAISWAL	R K JAISWAL

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :		DATE:17.04.2020 SHEET 3 OF 9
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04		
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					6	7				8	9	*	**	D	M	C	N
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-				
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-				
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-				
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-				
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-				
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY			
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-				


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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH JAISWAL	R K JAISWAL

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


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

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS

STANDARD QUALITY PLAN

SPEC. NO :

CUSTOMER :

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SYSTEM:

SECTION: II


SHEET 6 OF 9

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




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

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



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

NOTES:

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.
- 4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.
- 5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.
- 6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.
- 7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.
- 8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.
- 9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.
- 10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

TENTATIVE MAKE OF LT MOTORS, GLAND AND LUGS

ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
ES53	LV MOTORS (NON FLAME PROOF)	1	A24	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003	0129-2567580, 09871799449	
		2	E1027	BHARAT BULEE LTD.	BHARAT BULEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.	Tel.: + 91 (11) 25816931-33, 35 & 36 DT: +91 25724318 Fax: + 91 (11) 25819640 M:+ 91 9818 121132 www.bharatbulee.com	
		3	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA	91 11 23460700- 999 Sunil.Das@cgglobal.com	
		4	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI- 600032	044-49681447	
		5	K01	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055	Tel: +91-80-23374865 Fax: +91-80- 23377706	
		6	I04	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA	0217- 2357001-005	APPROVED UPTO 200KW
		7	M01	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006	Ph: +91-129-2286421, 2265340, 4006601 to 4006610	
		8	A35	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045	Ph: (011) 2539 7763	
		9	E1115	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053	91-22-26730823, 26730789; 91)-(22)-26730154	
		10	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
ES11	CABLE GLANDS	1	E1201	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA	Mr. Vijay Mohan Sood +(91)-(120)-2525694 +(91)-(120)-3052594 +(91)-(11)-23287156	
		2	E1017	ARUP ENGG & FOUNDRY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068	033 2473 0850	
		3	E1206	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018	44-24995505,22680990-4	
		4	E1036	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063	91-022-26852961/62/63 comet@vsnl.net	
		5	DW08	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/ 022-29270878.	
		6	E1044	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059	91-22-28324829 / 66919034 devang@electromacglands.com	
		7	I01	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001	91-33-2480161/62/63/64 Fax : 91-33-2485766	
ES12	CABLE LUGS	1	E1040	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/ 022-29270878.	
		2	E1149	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA- 700001	033 2282 2540	

Makes shall be subject to customer/ BHEL approval at contract stage without any price implication to BHEL.



**3 x 200MW + 3 x 500 MW NTPC
RAMAGUNDAM STPS STG- I & II (FGD SYSTEM)
HVAC SYSTEM
TECHNICAL SPECIFICATION
(C&I PORTION)**

SPECIFICATION No: PE-TS-467-(571-13000-A)-A001

SECTION : I

SUB-SECTION : C-4


REV. 00

SECTION: I

**SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**

	3X200 + 3X500 MW NTPC RAMAGUNDAM TPP STAGE I & II- FGD	
	TECHNICAL SPECIFICATION (C&I) FOR HVAC SYSTEM	

**TECHNICAL SPECIFICATION
 (CONTROL AND INSTRUMENTATION)
 FOR HVAC SYSTEM**

	3X200 + 3X500 MW NTPC RAMAGUNDAM TPP STAGE I & II- FGD	DESG	SK	
	JOB NO: 467	CHKD	SCS	
	REV. NO. 01	DATE: 24.07.2020	APPD	SCS

**3X200 + 3X500 MW NTPC RAMAGUNDAM TPP
STAGE I & II- FGD**

**TECHNICAL SPECIFICATION (C&I) FOR
HVAC SYSTEM**

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	LIST OF DOCUMENTS/DELIVERABLES
5	SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY), VFD ,ELEC ACTUATOR AND LOCAL CONTROL PANEL
6	INSTRUMENTATION CABLE ,CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
7	INSTRUMENT STUB DETAILS
8	INSTRUMENT INSTALLATION DRAWINGS
9	SIGNAL EXCHANGE BETWEEN DRIVES AND DCS
10	DRIVE AND INSTRUMENT INTERFACE DIAGRAM
11	QUALITY ASSURANCE FOR INSTRUMENTS & STARTER PANEL/LCP AND TYPE TEST REQUIREMENTS
12	MANDATORY SPARES
13	SUB VENDOR LIST



**C&I SPECIFICATION FOR
HVAC SYSTEM**

SECTION: C
SUB SECTION: C&I

**C&I SPECIFIC TECHNICAL REQUIREMENT
FOR DCS BASED
HVAC SYSTEM**



C&I SPECIFICATION FOR HVAC SYSTEM

SECTION: C
SUB SECTION: C&I

Specific Technical Requirements (C&I):

- 1.0 Air Conditioning and Ventilation System shall be operated from DDCMIS (BHEL's scope) for Area's/Building indicated elsewhere in the specification.
- 2.0 Interface of MCC, field Equipment, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
- 3.0 Microprocessor based controls of Air cooled condensing unit (D-X type), PAC (if applicable) etc. shall be provided with local display along with facilities to Soft link & Hardwired interface with DDCMIS and to meet the requirement of all system operations and controls. Soft link communication between Microprocessor (MP) based control panels & DDCMIS shall be redundant Bi-directional via TCP/IP on OPC or MODBUS with RS485 link. Bidder shall include required hardware at MP end.
- 4.0 Time synchronization of MP with DCS is to be carried out. Necessary hardware/software for same at MP end to be provided by Bidder
- 5.0 Bidder to supply all the instruments required for the package along with necessary fittings, accessories and valve manifold etc. for control monitoring and operation of HVAC system. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.
- 6.0 All the Electronic Transmitter for Pressure, Temperature, Differential Pressure and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA protocol compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.
- 7.0 The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.
- 8.0 All transmitters (except PROFIBUS PA compatible transmitters) shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART).
- 9.0 All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply.



**C&I SPECIFICATION FOR
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- 10.0 All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware.
- 11.0 Use of process actuated switch shall be avoided unless unavoidable.
- 12.0 All transmitters 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.
- 13.0 All field instruments enclosure shall be IP65, local panel/cabinet enclosure shall be IP 55, unless otherwise specified.
- 14.0 All instruments (except PROFIBUS PA compatible transmitters) and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
- 15.0 Electrical Actuators (as applicable) shall be Non-Intrusive type electric actuators envisaged with integral starter. The interface of these actuators with DCS shall be of two types viz. with Hardwired interface and with PROFIBUS DP interface. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body. Open/Close command termination logic suitably built inside the actuator Details shall be referring in the specification.
- 16.0 All ON, OFF, INCHING Type electric actuators shall be PROFIBUS DP compatible. However, the exact protocol shall be based on finalized protocol of DCS. If PROFIBUS DP protocol is envisaged, then actuator shall have two (redundant) PROFIBUS DP ports for connecting the redundant PROFIBUS DP cables. That is if one PROFIBUS DP cable is cut or not working/not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.
- 17.0 AHU shall be started either locally or from the main FGD control room by means of Remote / Manual selection facility.
- 18.0 Local control panel if any required for operation shall be in bidder scope.



**C&I SPECIFICATION FOR
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- 19.0 LCP (If applicable) shall have the provision of command (start/stop) & feedback interface with plant FGD-DCS
- 20.0 Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD control system.
- 21.0 VFD panels for applicable drives are in Bidders scope. Typical signal exchange with DCS has been indicated in the specification elsewhere.
- 22.0 Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.
- 23.0 Bidder to include IO from fire protection system (supplied by others) for closing the dampers in the event of fire, the no of IO & other specifications in this regard shall be finalized during detail engineering.
- 24.0 Complete C&I system for Air Conditioning and Ventilation System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.
- 25.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Air Conditioning and Ventilation System. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
- 26.0 The quantity of instruments for the system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
- 27.0 Bidder to furnish electrical load/UPS load data during detailed engineering



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- 28.0 415V AC/ 230V UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board, changeover circuit in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
- 29.0 Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.
- 30.0 The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.
- 31.0 The make of the items shall be from sub-vendor list. However, the make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 32.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.
- 33.0 Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication
- 34.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.
- 35.0 Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents



**C&I SPECIFICATION FOR
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shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder

- 36.0 Instrument installation and accessories required for the same shall be in Bidder's scope and shall be subject to customer/BHEL's approval during detailed engineering.
- 37.0 Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.
- 38.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 39.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
- 40.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.
- 41.0 Redundancy of sensors shall be provided by bidder
(i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
(ii) For all other control functions dual redundancy of the sensors shall be provided by the bidders.
- 42.0 The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided/ minimized.
- 43.0 All panels, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).



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- 44.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.
- 45.0 The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a "No deviation" certificate is to be furnished.
- 46.0 All the instruments/equipments/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply
- 47.0 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments.
- 48.0 For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.
- 49.0 All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder's scope .
- 50.0 All instruments should be supplied with valid calibration and test certificates provided by OEM.
- 51.0 The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback.
- 52.0 Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
- 53.0 At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.
- 54.0 The contacts of equipment mounted instruments; sensors, switches etc. For external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.



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- 55.0 Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm².
- 56.0 All the instruments PG/DPG/DPT/PT etc. (as applicable) having contact with corrosive media shall be provided with chemical/diaphragm seal.
- 57.0 Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
- 58.0 Bidder's presence is required for minimum 09 Man days (in three visits, excluding travel time) at site in which each visit shall be of minimum 03 Man days during commissioning of DCS for assistance related to process correctness. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
- 59.0 Bidder's representative (process/ C&I owner) shall be present at BHEL-PEM Office for minimum 03 man-days, for preparation of Control scheme and operation and control philosophy of AC and ventilation system. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope
- 60.0 Number of pairs to be selected for Screen/ Control cable
- (a) F-Type: 2P/4P/8P/12P(Size : 0.5 mm²)
 - (b) G-Type: 2P/4P/8P/12P(Size : 0.5 mm²)
 - (c) Core Cable: 3CX2.5sqmm²/ 5CX2.5sqmm²/ 12CX1.5sqmm²
- 61.0 Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.



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62.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section "List Of Documents/Deliverables".

- GA & wiring diagram of local panel.
- Power requirement.
- Local control panel & instruments data sheet.
- Instrument schedule
- Alarm Schedule
- Control scheme
- Control write-up
- Any other document decided during detailed engineering

Note:-


1. All equipment items shall be of latest design with proven on track record.
2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.



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**GENERAL TECHNICAL REQUIREMENTS
(HVAC SYSTEM)**

	SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF
<p>GENERAL REQUIREMENT</p> <p>1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.</p> <p>2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.</p> <p>3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.</p> <p>4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.</p> <p>5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.</p>			



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LIST OF DOCUMENTS/DELIVERABLES



C&I SPECIFICATION FOR HVAC SYSTEM

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LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT

Sl. No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V4-467-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V4-467-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V4-467-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V4-467-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V4-467-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V4-467-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V4-467-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V4-467-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V4-467-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V4-467-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V4-467-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V4-467-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V4-467-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:

ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.


CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL, MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.




**C&I SPECIFICATION FOR
HVAC SYSTEM**

SECTION: C
SUB SECTION: C&I


**MEASURING INSTRUMENTS
(PRIMARY & SECONDARY), VFD,
ELECTRICAL ACTUATOR & LCP**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
<p>1.00.00</p> <p>1.01.00</p> <p>1.02.00</p> <p>1.03.00</p> <p>1.04.00</p> <p>1.05.00</p> <p>1.06.00</p> <p>1.07.00</p>	<p>MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)</p> <p>Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.</p> <p>Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.</p> <p>All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.</p> <p>The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.</p> <p>All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).</p> <p>For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications.</p> <p>For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.</p> <p>For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.</p> <p>The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation.</p>			
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2</p>	<p>SUB-SECTION-III-C2 MEASURING INSTRUMENTS</p>	<p>PAGE 1 OF 34</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS									
16.00.00	<p>FIELD INSTRUMENTS BASED ON FIELDBUS</p> <p>The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.</p>									
16.01.00	<p>Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.</p> <table border="1" data-bbox="347 1579 1463 1697"> <thead> <tr> <th data-bbox="347 1579 459 1615">S No.</th> <th data-bbox="459 1579 746 1615">Features</th> <th data-bbox="746 1579 1463 1615">Essential/Minimum Requirements</th> </tr> </thead> <tbody> <tr> <td data-bbox="347 1659 459 1697">1.</td> <td data-bbox="459 1659 746 1697">Type of Transmitter</td> <td data-bbox="746 1659 1463 1697">FOUNDATION Fieldbus/PROFIBUS PA based output</td> </tr> </tbody> </table>				S No.	Features	Essential/Minimum Requirements	1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output
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<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2</p>	<p>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</p>	<p>PAGE 5 OF 8</p>							


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>2 Accuracy</p> <p>3. Stability</p> <p>4 Turn down</p> <p>5 Housing</p> <p>6. Electrical connection</p> <p>7. Process connection</p> <p>8. Operating Ambient temperature</p> <p>Overpressure</p> <p>9 Accessories</p>	<p>± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc.</p> <p>+0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2.</p> <p>± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.</p> <p>0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer.</p> <p>0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer.</p> <p>0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.</p> <p>50:1 for greater than or equal to span of 400mmwcl.</p> <p>20:1 for span below 400mmwcl.</p> <p>10:1 for span greater than 250 kg/cm2</p> <p>(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).</p> <p>Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</p> <p>½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible</p> <p>½” NPT (F)</p> <p>85 deg C without display.</p> <p>70 deg C with display.</p> <p>150% of max operating pressure</p> <p>-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.</p> <p>-2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications.</p> <p>-The valve manifold shall be non-integral type.</p> <p>-For hazardous area, enclosure as described in NEC article 5.</p>	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 6 OF 8


CLAUSE NO.	TECHNICAL REQUIREMENTS																								
	<p>10. Mounting</p> <p>11. Diagnostics & display</p> <p>Notes</p> <ul style="list-style-type: none"> - For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc. - LVDT type is not acceptable. - Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 	<p>2 inch pipe mounting with Enclosure/Rack/Canopy.</p> <p>Self-Indicating feature and digital display on transmitter</p>																							
16.02.00	Temperature Transmitter																								
16.02.01	<p>Single Input /Dual Input Temperature transmitter</p> <p>Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.</p> <p>Following specifications are applicable for dual input/single input temperature transmitter.</p> <table border="1" data-bbox="379 1335 1436 1877"> <thead> <tr> <th>S No.</th> <th>Features</th> <th>Essential/Minimum Requirements</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Output</td> <td>FOUNDATION fieldbus /PROFIBUS PA</td> </tr> <tr> <td>2.</td> <td>Input</td> <td>Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types</td> </tr> <tr> <td>3.</td> <td>Housing</td> <td>Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</td> </tr> <tr> <td>4.</td> <td>Electrical connection</td> <td>½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible</td> </tr> <tr> <td>5.</td> <td>Diagnostics display</td> <td>& Self-Indicating feature and digital display on transmitter</td> </tr> <tr> <td>6.</td> <td>Operating Ambient temperature</td> <td>85 deg C without display. 70 deg C with display.</td> </tr> </tbody> </table>				S No.	Features	Essential/Minimum Requirements	1.	Output	FOUNDATION fieldbus /PROFIBUS PA	2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types	3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	4.	Electrical connection	½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible	5.	Diagnostics display	& Self-Indicating feature and digital display on transmitter	6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	<p>TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2</p>	<p>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</p>	PAGE 7 OF 8																						

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	7. Mounting 8. Accessories 9. Composite Accuracy	2 inch pipe mounting with Canopy. As required by service and operating condition. (Refer note 2) RTD = $\leq 0.25\%$ of 0-250 deg C span T/C-K type = $\leq 0.2\%$ of 0-600 deg C span CJC accuracy (for thermocouples) shall be = ≤ 1 deg C		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 8 OF 8

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.
2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
4. Dual input temperature transmitters can also be accepted in place of single input TT.

CLAUSE NO.	TECHNICAL REQUIREMENTS																										
3.02.00	<p>Resistance Temperature Detector (RTD)</p> <table border="0"> <thead> <tr> <th data-bbox="396 264 440 321">Sr. No.</th> <th data-bbox="488 264 594 289">Features</th> <th data-bbox="865 264 1263 289">Essential/Minimum Requirements</th> </tr> </thead> <tbody> <tr> <td data-bbox="396 359 407 384">1</td> <td data-bbox="488 359 639 384">Type of RTD.</td> <td data-bbox="865 359 1401 422">: Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).</td> </tr> <tr> <td data-bbox="396 457 407 483">2</td> <td data-bbox="488 457 651 483">No. of element</td> <td data-bbox="865 457 943 483">: Duplex</td> </tr> <tr> <td data-bbox="396 518 407 543">3</td> <td data-bbox="488 518 647 543">Housing/Head</td> <td data-bbox="865 518 1401 737">: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well</td> </tr> <tr> <td data-bbox="396 772 407 798">4</td> <td data-bbox="488 772 781 835">Insulation and sheathing of RTD</td> <td data-bbox="865 772 1401 835">: Mineral (magnesium oxide) insulation and SS316 sheath,</td> </tr> <tr> <td data-bbox="396 871 407 896">5</td> <td data-bbox="488 871 764 896">Calibration and accuracy</td> <td data-bbox="865 871 1401 934">: As per IEC-751/ DIN-43760 Class-A for RTD</td> </tr> <tr> <td data-bbox="396 970 407 995">6</td> <td data-bbox="488 970 623 995">Accessories</td> <td data-bbox="865 970 1263 995">: Thermo well and associated fittings</td> </tr> <tr> <td data-bbox="396 1031 407 1056">7</td> <td data-bbox="488 1031 591 1056">Standard</td> <td data-bbox="865 1031 1401 1094">: IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.</td> </tr> </tbody> </table> <p>NOTES :</p> <ol style="list-style-type: none"> 1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100. 2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. 		Sr. No.	Features	Essential/Minimum Requirements	1	Type of RTD.	: Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).	2	No. of element	: Duplex	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well	4	Insulation and sheathing of RTD	: Mineral (magnesium oxide) insulation and SS316 sheath,	5	Calibration and accuracy	: As per IEC-751/ DIN-43760 Class-A for RTD	6	Accessories	: Thermo well and associated fittings	7	Standard	: IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.	
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3.03.00	<p>Metal Temperature Thermocouples</p> <table border="0"> <tbody> <tr> <td data-bbox="396 1556 610 1581">Measuring Medium</td> <td data-bbox="740 1556 951 1581">Metal Temperature</td> </tr> <tr> <td data-bbox="396 1612 688 1638">Material of Thermocouple.</td> <td data-bbox="740 1612 1008 1638">Chromel Alumel Type K</td> </tr> <tr> <td data-bbox="396 1669 651 1694">Type of Thermocouple</td> <td data-bbox="740 1669 1263 1694">Duplex with ungrounded separate hot junctions</td> </tr> <tr> <td data-bbox="396 1726 505 1751">Insulation</td> <td data-bbox="740 1726 1170 1751">Mineral Insulation (Magnesium Oxide).</td> </tr> </tbody> </table>		Measuring Medium	Metal Temperature	Material of Thermocouple.	Chromel Alumel Type K	Type of Thermocouple	Duplex with ungrounded separate hot junctions	Insulation	Mineral Insulation (Magnesium Oxide).																	
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 9 OF 34																							

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.04.00	<p>Thermocouple wire gauge 16 AWG</p> <p>Protective sheath SS 321</p> <p>Protective sheath dia 8 mm OD</p> <p>Calibration & accuracy As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C</p> <p>Mounting accessories 1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.</p> <p>Cold end sealing SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.</p> <p>Minimum bending radius 30 mm</p> <p>Length of T/C On as required basis considering location of measurement point and the JB/TTJB location.</p> <p>Notes :</p> <p>1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.</p> <p>Thermo well (for all process temp. elements)</p> <p>(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)</p> <p>(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.</p> <p>(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).</p> <p>(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.</p>		
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2</p>	<p>SUB-SECTION-III-C2 MEASURING INSTRUMENTS</p>	<p>PAGE 10 OF 34</p>

4.00.00

SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

SI. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.	Inert gas actuated/ Liquid filled other than mercury	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Material of sensing element	SS 316	SS 316	
3	Material of movement	SS 304	SS 304	
4	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
5	Dial size	150mm	150 mm	Tubular covering entire range
6	End connection	1/2 inch NPT (M)	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB



CLAUSE NO.	TECHNICAL REQUIREMENTS			
7	Accuracy	±1% of span	± 1% of span	± 2%
8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
10	Over range	125% of FSD	125% of FSD	-
11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
12	Zero/span adjustment	Provided	Provided	--
13	Identification	Engraved with service legend or laminated phenolic name plate		
14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
Notes:-				
*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				



CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.00.00	PROCESS ACTUATED SWITCHES		
	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS	
		Pressure/ Draft Switches/ Switches DP	Temperature switches Level switches
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application) Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
	Material	316 SS	Bulb 316 SS/ capillary 304 SS 316 SS
	End connection	½ inch NPT (F)	½ inch NPT (F) Manufacturer standard
	Over range/ proof pressure	150% of maximum operating pr.	- 150% of maximum operating pr.
	Repeatability	+/- 0.5% of full range	
	No. of contacts	2 No.+2NC. SPDT snap action dry contact	
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)	
	Elect. Connection	Plug in socket.	
	Set point adjustment	Provided over full range.	
	Dead band adjustment	Adjustable/ fixed as per requirement of application.	
	Enclosure	Weather and dust proof as per IP-55, metallic housing.	
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting -

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 14 OF 34
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<table border="1"> <tr> <td data-bbox="336 210 552 331">Power Supply (wherever required)</td> <td data-bbox="552 210 1465 331">As per Contractor's Standard practice.</td> </tr> <tr> <td colspan="2" data-bbox="336 331 1465 880"> <p>Notes :-</p> <ol style="list-style-type: none"> 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. </td> </tr> </table>	Power Supply (wherever required)	As per Contractor's Standard practice.	<p>Notes :-</p> <ol style="list-style-type: none"> 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. 	
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6.00.00	<p>SOLENOID VALVES</p> <p>Solenoid valves shall fulfill the following requirements: -</p> <ol style="list-style-type: none"> a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.) b) Power supply 24V DC. c) Plug in connector connection. d) Insulation : Class "H" 				
7.00.00	<p>Limit switches</p> <ol style="list-style-type: none"> e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55. 				

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 15 OF 34
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HUMIDITY SENSOR


Sensor : Capacitance type
Accuracy : +/-3% R.H
Range : 0-100% R.H
Output : 4-20 ma
Time constant : 2 mins.

Output from the sensor is to be connected to respective control system. Contractor can also provide combined instrument for measurement of humidity and temperature subject to Employer's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

TEMPERATURE / HUMIDITY INDICATOR


Sensor : RTD for(Pt 100) for temperature
: Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
Display : Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
Range : 0-60 Deg C for temperature.
: 0-95.0 % for Relative Humidity.
Accuracy : Better than +/-0.5 % for Temperature
: Better than +/-2.5 % for Relative Humidity
Mounting : Table Top/ wall mounting.
Power supply : 240 V AC, 50 Hz.
Output : 4-20 mA signal each for temperature.

One Set of output signal is to be connected to respective control system. Apart from displaying the temperature/humidity values on indicator.


CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>1.00.00</p> <p>1.01.00</p> <p>1.02.00</p> <p>1.02.01</p> <p>1.02.02</p> <p>2.00.00</p> <p>2.01.00</p> <p>2.01.01</p> <p>2.01.02</p> <p>2.02.00</p> <p>2.03.00</p>	<p>GENERAL:</p> <p>Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.</p> <p>This sub-section of specification is applicable for following types of electric actuators:</p> <p>Modulating duty electric actuators:</p> <p>These shall be provided as per standard practice of OEM of equipment, meeting other requirements of specifications. For specifications of Blade pitch actuators, refer clause no. 5.00.00 of this chapter.</p> <p>Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):</p> <p>These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.</p> <p>COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS</p> <p>TYPE:</p> <p>The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.</p> <p>The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body.</p> <p>RATING:</p> <p>(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%.</p> <p>(b) Sizing:</p> <p>Open/Close at rated speed against designed differential pressure at 90% of rated voltage.</p> <p>For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.</p> <p>For inching type: 150 starts per hour or required cycles, whichever is higher.</p> <p>CONSTRUCTION:</p> <p>(a) Enclosure:</p> <p>Totally enclosed weatherproof, minimum IP-68 degree of protection.</p> <p>(b) Manual Wheel:</p> <p>Shall disengage automatically during motor operation.</p>		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS	PAGE 1 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>2.04.00</p>	<p>MOTOR:</p> <p>(a) Type : Squirrel cage induction motor suitable for Direct On Line (DOL)starting.</p> <p>(b) Enclosure: Totally enclosed, self-ventilated.</p> <p>(c) Insulation Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.</p> <p>(d) Bearings: Double shielded, grease lubricated antifriction.</p> <p>(e) Earth Terminals: Two</p> <p>(f) Protection: Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.</p>		
<p>2.05.00</p>	<p>POSITION/TORQUE TRANSMITTER:</p> <p>The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.</p>		
<p>2.06.00</p>	<p>LOCAL OPERATION:</p> <p>It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.</p>		
<p>2.07.00</p>	<p>LCD DISPLAY:</p> <p>A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.</p>		
<p>2.08.00</p>	<p>WIRING:</p> <p>Suitable voltage grade copper wire.</p>		
<p>2.09.00</p>	<p>TERMINAL BLOCK:</p> <p>For power cables, the grade of TBs shall be minimum 650V.</p>		
<p>2.10.00</p>	<p>ACCESSORIES:</p> <p>All required accessories (if applicable) for calibration / settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.</p>		
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS</p>	<p>PAGE 2 OF 4</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.11.00	<p>SIL CERTIFICATION: All actuators shall be certified for SIL 2 or better.</p>		
3.00.00	<p>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS</p>		
3.01.00	<p>INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only.</p> <p>(a) Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired.</p> <p>(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly suitable isolated interface in the actuator shall be provided.</p> <p>(c) Open/close command termination logic shall be suitably built inside actuator.</p> <p>(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable)</p>		
3.02.00	<p>TERMINAL BOX: Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.</p>		
3.03.00	<p>TRAINING: Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.</p>		
4.00.00	<p>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS</p>		
4.01.00	<p>INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.</p> <p>(a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.</p> <p>(b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.</p> <p>(c) Open/close command termination logic shall be suitably built inside actuator.</p>		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS	PAGE 3 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS 
4.02.00	<p>TERMINAL BOX:</p> <p>Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.</p>

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS	PAGE 4 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
10.02.00				
10.03.00				
10.04.00				
11.00.00				
12.00.00	<p>Electric Actuators</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(3)-9</p>	<p align="center">PART-A SUB-SECTION-III-C (C&I)</p>	<p align="center">PAGE 17 OF 19</p>	



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, **supervision, erection, and commissioning at site** of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
- b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
- c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/**LED cluster**, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and **stiffeners** as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 **The salient features of construction shall be:**

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

**Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others**

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable **stiffeners** to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. **Double door shall be provided with suitable glass windows, as per the requirement.**

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation **system along with louvers** shall be provided at bottom and top of the doors covered with removable wire mesh.



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- 3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function. No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. **The TB points in terminal block shall be cage clamp type / screw type.** The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm **height from finished floor.** **The panel shall have ten (20) percent spare terminal.**
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent **lamps / tube lights with shrouded cover of minimum 15W** operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.