

NTPC LIMITED

RAMAGUNDAM (STG - I & II) (3x200 MW+ 3x500 MW)

TECHNICAL SPECIFICATION

FOR

GYPSUM DEWATERING EQUIPMENT

SPECIFICATION NO.: PE-TS-467-571-A901, Rev 00



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



NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)

SPECIFICATION No: PE-TS-467-571-A901

GYPSUM DEWATERING EQUIPMENT

SECTION

REV. 00

TECHNICAL SPECIFICATION

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**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)****GYPSUM DEWATERING EQUIPMENT
TECHNICAL SPECIFICATION****SPECIFICATION No: PE-TS-467-571-A901****SECTION: I****REV. 00****SECTION - I**

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**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

**GYPSUM DEWATERING EQUIPMENT
TECHNICAL SPECIFICATION**

INTENT OF SPECIFICATION

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SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYPHUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-467-571-A901	
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1.0 **INTENT OF SPECIFICATION**

1.1 This specification covers Supply part, Services part and Mandatory Spares; comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, first fill and top-up of lubricants & consumables, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND Services part covers supervision services for erection & commissioning, trial run at site and carrying out Performance Guarantee tests at site, training of customer's personnel at manufacturer's works covering design familiarization, training on product design features etc. (6 man-days including lodging and boarding), training of customer's O&M staff covering all aspects of the GDS-Operation & Maintenance, Troubleshooting etc. (6 days) at Site & handover of the package in flawless condition to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order of **Gypsum Dewatering Equipment**, a sub-assembly of the Flue Gas Desulphurization (FGD) package of **RAMAGUNDAM Stage - I & II (3X200 MW + 3x500 MW)** of M/s NTPC Limited.

1.2 Two (02) Sets of Gypsum Dewatering Equipment (1 working + 1 standby) common for both the stages shall be provided.

1.3 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and comprehensive 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 the **GYPHUM DEWATERING EQUIPMENT**.

1.4 The Bidder shall offer only proven design, which meets the Provenness criteria indicated in the NIT. Necessary documentary evidences shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their bid may not be considered for further evaluation.

1.5 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to the highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to the 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.

1.6 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 equipment for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically

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	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYPSUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-467-571-A901	
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excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

1.7 The general term and conditions, instructions to tenderers and other attachment(s) referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to the compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.8 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarification(s), in case of any contradictory requirement, the more stringent requirement as per the 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.

1.9 The bidder's offer shall not carry any section like clarification, interpretations and /or assumptions.

1.10 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Section -III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.

1.11 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/ standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner /purchaser shall apply.

1.12 In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.13 For definition of words like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please refer relevant clause of General Conditions of Contract (GCC).

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**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

GYP SUM DEWATERING EQUIPMENT

PROJECT INFORMATION

SPECIFICATION No: PE-TS-467-571-A901

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PROJECT INFORMATION

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SUB-SECTION-II-A5

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	Background			
	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.			
1.01.00	Location and Approach			
	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. 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. Vicinity plan of the proposed project is placed at Annexure –I.			
1.02.00	Not Used			
1.03.00	Unit Capacity			
	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.			
1.04.00	Equipment cooling water			
	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.			
1.05.00	Coal Quality Parameters / Fuel Oil Characteristics			
	Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details: (i) The Coal quality parameters and Fuel Oil characteristics are indicated in Table-1 & Table-2 respectively below. (ii) Process water: Process water quality is CW Blowdown based on the COC indicated in Table-4. (iii) Clarified water:			
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 1 OF 32

CLAUSE NO.	PROJECT INFORMATION			
1.06.00 1.07.00 2.00.00 3.00.00 4.00.00 5.00.00	Clarified water quality is indicated in Table-4. (iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-5.			
	Steam Generator and ESP data: refer Table-6.			
	Drawings are enclosed as per Table-7 for initial overview to the Bidder.			
	NOT USED			
	Capacity Stage-I 3 x 200 MW Stage-II 3 x 500 MW			
	Metrological Data The metrological data from nearest observatory is placed at Annexure-II.			
	Criteria for Earthquake Resistant Design of Structures and Equipment All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).			
	LOT-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 2 OF 32

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	Damping in Structures		
	The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:		
	a)	Steel structures	: 2%
	b)		: 5%
	Reinforced Concrete structures		
	c)	Reinforced Concrete Stacks	: 3%
	d)	Steel stacks	: 2%
	Method of Analysis		
	Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).		
	In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).		
The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.			
For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B/ V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B .			
Design/Detailing for Ductility for Structures			
The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.			
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CLAUSE NO.	PROJECT INFORMATION		
	APPENDIX – I SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration (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 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 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.		
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CLAUSE NO.	PROJECT INFORMATION		
	APPENDIX – I <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration (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 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 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.		
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 5 OF 32

CLAUSE NO.	PROJECT INFORMATION			
	ANNEXURE-A			
	<u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u> <u>(In units of 'g')</u>			
	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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CLAUSE NO.	PROJECT INFORMATION													
6.00.00	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT													
	All structures shall be designed for wind forces in accordance with IS: 875 (Part-3) and as specified in this document. See Annexure – B for site specific information.													
	Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.													
	Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.													
	Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.													
	Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.													
	It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.													
	Damping in Structures													
	The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:													
	<table><tr><td>a) Welded steel structures</td><td>:</td><td>1.0%</td></tr><tr><td>b) Bolted steel structures/RCC structures</td><td>:</td><td>2.0%</td></tr><tr><td>c) Prestressed concrete structures</td><td>:</td><td>1.6%</td></tr><tr><td>d) Steel stacks</td><td>:</td><td>As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>			a) Welded steel structures	:	1.0%	b) Bolted steel structures/RCC structures	:	2.0%	c) Prestressed concrete structures	:	1.6%	d) Steel stacks	:
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.												
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 9 OF 32										

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CLAUSE NO.	PROJECT INFORMATION
	ANNEXURE-B SITE SPECIFIC DESIGN PARAMETERS The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed “V_b” at ten metres above the mean ground level : 44 meters/second b) The risk coefficient “K₁” : 1.07 c) Category of terrain : Category-2
7.00.00	FOUNDATION SYSTEM AND GEOTECHNICAL DATA
7.00.01	Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.
7.00.02	The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.
7.00.03	The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable
7.00.04	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.
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 10 OF 32	

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7.02.00	c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.		
	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.		
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. h) The water table for design purpose shall be considered at Finished Ground Level. i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. j) Foundation for equipments on ground floor For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.		
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7.02.02	For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling with the load intensity below the equipment limited to 4T/m². The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications. For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 2. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.			
	Open Foundations In case open foundations are adopted, following shall be adhered to. - The minimum width of foundation shall be 1.0 m. - Minimum depth of foundation shall be 1.0m below Ground Level. - It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. - Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.			
7.02.03	Pile Foundations – In case piles are adopted, following shall be adhered to : - The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs. However, conventional tripod rig may be allowed in inaccessible areas subject to site specific conditions. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer. If required, temporary or permanent MS liner may be provided for piling. - The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure: - Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. - The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.			
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	v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval. vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part). viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter. ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under : i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.			
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	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.			
7.03.00	Special Requirements			
7.03.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried			
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		out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.		
	7.04.00	Excavation, Filling and Dewatering		
	7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.		
	7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.		
	7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils		
		Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.		
	7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.		
	7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.		
	7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.		
		Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.		
	7.05.00	EXCAVATION IN ROCK		
		Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.		
	7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).		
	7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme &		
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	initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.00	Geotechnical Investigation The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.			
7.07.01.00	Scheme of geotechnical Investigation			
7.07.02.01	Field test shall include but not be limited to the following: Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.			
7.07.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.			
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.			
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7.07.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers. Laboratory Tests on Soil Samples Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel. Laboratory Tests on Rock Samples Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.													
7.07.02.05	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards. On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc. Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.													
7.07.03.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies. 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad													
7.08.00	Geotechnical Investigation Scheme a) Boreholes (Minimum) <table border="1"> <thead> <tr> <th>S.No</th><th>Structure</th><th>Spacing/Number of borehole</th><th>Depth of borehole</th><th>Remarks</th></tr> </thead> <tbody> <tr> <td>1</td><td>FGD</td><td>Minimum 14 Nos.</td><td>Depth of boreholes shall be 25m to 35m.</td><td>Depth of boreholes</td></tr> </tbody> </table>				S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of boreholes
S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks										
1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of boreholes										
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	2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.
	3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 15m to 25m	
	4	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m	
	5	Chimney	Minimum 2 Nos.	30 to 35m	
	b) Other Field Tests (Minimum)				
	1	Cyclic Plate Load Test (CPLT)	3 nos	Test Depth from 2 to 4 m	
	2	TRIAL PIT (TP)	5 Nos.	Depth - 3 m	
	3	IN SITU PERMEABILITY TEST IN BOREHOLES	In minimum 3 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.	
	4	ERT	Minimum 10 Nos.		
	• Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work. • Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.				
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जलवायवी सारणी
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मौसम परिचय										चक्र		मेघ										दृश्यता		
के मास हिनो की संख्या										चक्र की गती के मास हिनो की संख्या (कि. मी. प्र. घं.)		मेघ मात्रा (सभी मेघ) सही हिनो की संख्या - अणुमात्रा										दृश्यता सही हिनो की संख्या		
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WEATHER PHENOMENA										No. OF DAYS WITH WIND SPEED (Km. p. h.)		No. OF DAYS WITH LOW CLOUD AMOUNT (ALL CLOUDS) OK T AS										No. OF DAYS WITH VISIBILITY		
No. OF DAYS WITH										PERCENTAGE No. OF DAYS WIND FROM		No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OK T AS										No. OF DAYS WITH VISIBILITY		
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	ANNEXURE-III SOIL DATA AND FOUNDATION SYSTEM (Ramagundam-I&II) Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of available boreholes solely for bidder's information in the vicinity of proposed area are enclosed with this Annexure. The bidder is required to carry out geotechnical investigation as per Clause No 7.07.00 & 7.08.00 and ascertain the bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. The existing ground level is varying as per enclosed contour/spot level drawing. a) The foundation system to be adopted for different structures shall be as given in Table – 1 below <table><tr><th colspan="2">Table – 1: Net Allowable Bearing Pressure</th></tr><tr><th>STRUCTURE</th><th>TYPE OF FOUNDATION TO BE ADOPTED</th></tr><tr><td>FGD and related structures</td><td>Open</td></tr></table> b) Bidder is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-2. <table><tr><th colspan="4">Table – 2: Net Allowable Bearing Pressure</th></tr><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing PressureT/m2</th></tr><tr><td>Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata</td><td>Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata</td><td>Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata</td></tr><tr><td colspan="2">Width upto 6.0m</td><td></td></tr><tr><td colspan="4">In case of Soil</td></tr><tr><td>2.0m below NGL</td><td>8</td><td>10</td><td>12</td></tr></table>	Table – 1: Net Allowable Bearing Pressure		STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	FGD and related structures	Open	Table – 2: Net Allowable Bearing Pressure				Founding Depth/ Stratum	Net Allowable Bearing PressureT/m2			Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata	Width upto 6.0m			In case of Soil				2.0m below NGL	8	10	12
Table – 1: Net Allowable Bearing Pressure																													
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED																												
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2.0m below NGL	8	10	12																										
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 22 OF 32																										

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	3.0m below NGL		10	12	15
	4.0m below NGL		14	16	18
	In case of rocky strata				
	1.0m Embedment in SDR (soft disintegrated rock)		30	30	30
	0.6m Embedment in fractured sandstone rock.		40	40	40
	1.0m Embedment in fractured sandstone rock.		45	45	45
	- For NGL, topographical survey drawing along with borehole details carried out by bidder shall be referred.				
	The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.				
	c) Permissible Settlement of Foundations:				
	For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:				
	Isolated, Strip & Raft (machine foundation)		25 mm		
	Isolated & Strip (Other than machine foundation)		40 mm		
Raft (widths greater than 6 m) (Other than machine foundation)		75 mm			
Foundations in rock		12 mm			
In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.					
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 23 OF 32

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Table :1**COAL AND ASH CHARACTERISTICS**

Coal Properties for Ramagundam ESP Augmentation				
S.No.	Characteristics	Range of Coal Supplies 95%		
	(as received basis)	Column - 1	Column - 2	Column - 3
1.0	PROXIMATE ANALYSIS	Design	Worst	Best
1.1	Total Moisture (%)	12	15	11
1.2	Ash (%)	42	45	35
1.3	Volatile Matter (%)	22	20	24
1.4	Fixed Carbon (%)	24	20	30
1.5	Total (%)	100	100	100
2.0	ULTIMATE ANALYSIS			
2.1	Carbon (%)	35.28	30.72	40.68
2.2	Hydrogen (%)	2.54	2.3	2.73
2.3	Sulphur (%)	0.45	0.6	0.4
2.4	Nitrogen(%)	0.68	0.6	0.85
2.5	Oxygen(%) (By difference)	7.05	5.78	9.38
2.6	Total Moisture (%)	12	15	11
2.7	Ash (%)	42	45	35
	Total	100	100	100
2.10	GCV (Kcal/Kg)	3400	3000	3800
2.11	Hard Grove Index	50	47	55
3.0	ASH ANALYSIS			
3.1	Silica (%)	61.85	61.3	62.4
3.2	Alumina(%)	27.36	27.42	27.31
3.3	Iron Oxide (%)	5.18	5.4	4.96
3.4	Titania	1.84	1.8	1.88
3.5	Phosphoric Anhydride (%)	0.54	0.54	0.55
3.6	Lime (%)	1.47	1.52	1.42
3.7	Magnesia (%)	1	0.97	1.03
3.8	Sulphuric Anhydride (%)	0.05	0.05	0.05
3.9	Sodium Oxide (%)	0.2	0.08	0.04
3.1	Balance Alkalies (by difference)	0.51	0.92	0.36
	Total	100	100	100
4.0	ASH FUSION RANGE			
	REDUCING ATMOSPHERE			
4.1	Initial Deformation Temp. (oC)	1150	1100	1200
4.2	Hemispherical Temp. (oC)	1300	1250	1350
4.3	Fusion Temperature (oC)	1400	1350	1400

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CLAUSE NO.	PROJECT INFORMATION				
	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

CLAUSE NO.	PROJECT INFORMATION																				
	TABLE-5 ANALYSIS OF DM WATER <table><tr><th>Sl.No.</th><th>Characteristics</th><th>Value</th></tr><tr><td>1.</td><td>Silica (Max.)</td><td>0.02 ppm as Sio2</td></tr><tr><td>2.</td><td>Iron as Fe</td><td>Nil</td></tr><tr><td>3.</td><td>Total hardness</td><td>Nil</td></tr><tr><td>4.</td><td>pH value</td><td>6.8 -7.2</td></tr><tr><td>5.</td><td>Conductivity</td><td>Not more than 0.1micro mho/cm excluding the effects of free CO2</td></tr></table>			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																		



**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

GYPSUM DEWATERING EQUIPMENT

TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-467-571-A901

SECTION : I

Sub Section : C

REV. 00

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATION

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00



NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)

GYP SUM DEWATERING EQUIPMENT

TECHNICAL SPECIFICATION
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-467-571-A901

SECTION : I

SUB-SECTION : C1

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SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00



**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

GYP SUM DEWATERING EQUIPMENT

**TECHNICAL SPECIFICATION
SPECIFIC TECHNICAL REQUIREMENT**

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1.1 FUNCTION

The purpose of the specification is to provide details of the complete Gypsum Dewatering Equipment (GDWE) for NTPC RAMAGUNDAM Stg - I & II (3x200+3x500) MW, under the scope of this tender.

1.2 TECHNICAL INFORMATION

1.2.1	Quantity of Gypsum De-Watering Equipment (GDWE)	Two (2) Sets (One working + One standby) common for Stage I & II Units (3x200 + 3x500) MW
1.2.2	Capacity of the Vacuum Belt Filter (VBF) in GDWE	74.5 Tones per hour (wet cake) minimum [≥ 67 TPH (dry)] at the outlet of Vacuum Belt Filter for each Belt Filter
1.2.3	Moisture content	10% (max)
1.2.4	Chloride content	100 ppm (max)
1.2.5	Gypsum purity	≥ 90% [by BHEL]

2.1 SCOPE OF SUPPLY & SERVICES

The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, first fill and top-up of lubricants & consumables, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site AND services part covers supervision services for erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of Customer's Engineering Personnel at manufacturer's works covering design familiarization, training on product design features etc. (6 man-days including lodging and boarding) , training of Customer's O&M staff covering all aspects of Operation & Maintenance, Troubleshooting etc. (6 days) at Site & handover in flawless condition of the package to the customer complete with all accessories.

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

Supply: Broadly includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting, packing & forwarding.

Services: Broadly includes supervision services for erection & commissioning, trial run at site and carrying out Performance Guarantee tests at site, training of Customer's Engineering Personnel at manufacturer's works covering design familiarization, training on product design features etc. (6 man-days including lodging and boarding), training of Customer's O&M staff covering all aspects of Operation & Maintenance, Troubleshooting etc. (6 days) at Site & handover in flawless condition of the package to the customer.

- 2.1.1 The scope of supply for Gypsum Dewatering Equipment shall include but not limited to the following: *(Wherever (*) is marked, one (1) set means complete requirement for both the Gypsum Dewatering Equipment)*

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2.1.1.1 Primary Hydro Cyclone: Two (2) sets

- i. Hydrocyclone clusters
- ii. Anchor bolts, nuts and washers
- iii. Flanges for inlet and overflow
- iv. A variety size of vortex finders for the entire hydro cyclone
- v. Accessory piping within the skid
- vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.2 Secondary hydro cyclone: Two (2) sets

- i. Hydrocyclone clusters
- ii. Anchor bolts, nuts and washers
- iii. Flanges for inlet and overflow
- iv. A variety size of vortex finders for the entire hydro cyclone
- v. Accessory piping within the skid
- vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.3 Vacuum belt filters complete with Accessories including discharge chute up to the gypsum conveyor skirt board (*width of Gypsum conveyor belt is 800 mm and that of skirt board is 533 mm*), driving motors (IE3) inverter duty with VFD and inverter panel: Two (2) numbers.

2.1.1.4 Vacuum receivers with Anchor bolts, nuts and washers: Two (2) numbers

Filtrate Extraction Pumps [2 nos., 1 nos./receiver tank (VBF): 1 working + 1 stand by] shall be provided. Refer Scheme No. PE-FEP-00 for the typical arrangement. The extraction system of the filtrate complete with pumps, piping, valves, instruments and accessories along with associated supports, fasteners, gaskets etc. with drive (IE3 motor). Also, bidder to include all connection bolts/nuts/washers for installation. Required instruments and any safety device shall be supplied.

Bidder to include the same in the P&ID scheme and submit the same for the approval of BHEL/ Customer.

2.1.1.5 Vacuum pumps with drive (IE3 motor), all connection bolts/nuts/washers for installation, required instruments and any safety device: Two (2) numbers

Bidder to consider the requirement of the vertical seal water sump pumps (2 nos., 1 working + 1 stand by) in scope for pumping the water expended from the Vacuum pump(s) to the Cake Wash Tank(s).

Civil work of the sump shall be in BHEL scope and inputs shall be provided by the bidder. The system shall be complete with pumps, valves, instruments and accessories along with associated supports, fasteners, gaskets etc. with drive (IE3 motor). Also, bidder to include all connection bolts/nuts/washers for installation. Required instruments and any safety device shall be supplied.

Bidder to include the same in the P&ID scheme and submit the same for the approval of BHEL/ Customer.

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYP SUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-467-571-A901	
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2.1.1.6 Vent fan including enclosure and its complete arrangement from VBF till exhaust: Two (2) numbers

2.1.1.7 Complete arrangement for cloth and cake washing (excluding tanks & their Instruments), pumps with motors (IE3), associated piping, valves, spray nozzles & accessories: One (1) set*

Two (2) nos. of belt filter wash tanks and Two (2) nos. cake washing tanks are envisaged for both the belt filters. Each tank shall be provided with 2 nos. (1 working + 1 standby) of wash pumps. Suitable arrangement for the washing of belt filter cloth and gypsum cake including piping/ valves/ instruments etc. shall be provided by the bidder.

The Scope of supply of Wash tank(s) with inlet/outlet nozzle and its instrumentation is in BHEL's scope. Inlet piping along with associated instruments/ valves from process/clarified water Terminal point (TP) outside the building, to the tanks inlet nozzles, Process/clarified water Outlet piping from the tanks outlet nozzles for cake wash and belt wash comprising of the wash pumps, their motors (IE3) along with associated instruments/ valves etc. shall be in the bidder scope.

However, bidder scope shall be limited to the Engineering as per clause 2.1.1.9 (ii) (g) of this sub-section for the overflow and drain of the tanks.

2.1.1.8 Coupling with guards, wherever applicable: One (1) set*

2.1.1.9 Piping, Valves and accessories

(i) Complete engineering and supply of interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable, shall be supplied in erectable condition i.e., no rubber lining to be done at Site), instruments, valves, supports, gaskets, fasteners and accessories which is integral to Gypsum Dewatering Equipment – One (1) set* which is broadly defined below:

- a. Slurry piping from Primary hydro cyclones underflow to Vacuum Belt Filters
- b. Filtrate piping from Vacuum belt filters to Vacuum receivers and further up to the extraction pumps discharge.
- c. Air piping from vacuum receivers to vacuum pumps to atmosphere
- d. Vacuum pumps seal water / drain water pipes to/ from wash tanks. Supply of seal water to vacuum pumps shall be provided through clarified water pump as specified in P & ID. Seal water drain from vacuum pump shall be collected in sump pit and shall be routed back to clarified water tank through seal water sump pump as mentioned at clause 2.1.1.5 above.
- e. Process/clarified water piping from TP outside building to wash tanks.
- f. Instrument air piping from TP outside building up to equipment related to the system.

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(ii) Scope of below-mentioned interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), instruments, valves, supports, gaskets, fasteners and accessories which is non-integral to Gypsum Dewatering Equipment is limited to engineering only and supply shall be made by BHEL. Engineering in bidder's scope includes layout & routing of pipes, preparation of isometric drawing and BOQ: a. Primary hydro cyclone feed tank outlet to the inlet flange of Primary hydro cyclones along with recirculation piping to feed tank b. Primary hydro cyclones over flow to Inlet of secondary hydro cyclone feed tank c. Secondary hydro cyclone feed tank outlet to inlet flange of secondary hydro cyclones along with recirculation piping to feed tank d. Secondary hydro cyclones underflow to filtrate tank e. Secondary hydro cyclones overflow to inlet flange of wastewater tank f. Vacuum receiver drain through filtrate extraction pumps (bidder scope) to Filtrate tank and other associated drains of vacuum belt filters to filtrate tank g. Overflow and drain piping of cake wash tanks and cloth wash tanks. 2.1.1.10 Expansion Joints at suction and discharge of each pump/other equipment, as applicable: One (1) Set* 2.1.1.11 Instruments/Valves for the entire Gypsum Dewatering Equipment including integral piping as defined at 2.1.1.9 above (minimum requirement for each Gypsum Dewatering Equipment is given in the P&ID): One (1) set* 2.1.1.12 Electrical part includes but not limited to i. Local control panel, if required ii. LV, HT Motors (as applicable) iii. Junction Box iv. Instruments v. Push buttons 2.1.1.13 All motors shall be provided with suitable double compression cable gland. Sizes of cables shall be informed by BHEL during detail engineering. Bidder to provide suitable gland with respect to sizes of cables. Bidder shall provide cable glands and lugs for all the equipments in his scope. Cables shall be terminated using double compression type cable glands and solderless crimping type tinned copper cable lugs. Bidder shall provide junction box. The Junction box shall have provision for installing glands of suitable size on the bottom of the box.			

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2.1.1.14 Control System: Control system shall be DDCMIS/ DCS, which shall be BHEL scope. Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected to a junction box. 2.1.1.15 SIGNALS [Refer Electrical/C&I portion/ P&IDs of this specification, as well] 2.1.1.15.1 Alarm Signal: - Bearing temperature high: Bidder shall supply bearing Temperature Transmitter for initiating alarm for "Bearing temperature high". Bearing temperature transmitter shall be provided with local display also. Bearing temperature transmitter (with 2V3 logic) shall be provided for HT motors (> 200 KW) at both the driving and non-Driving ends. - Vibration Monitoring System, is envisaged for HT Motor, which is in BHEL scope. However, for mounting of vibration sensors/probe on DE & NDE Bearing, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors with a provision i.e. M6x1 threaded hole, 13 mm deep, pre-drilled in each pads. Bidder to provide Single notch/slot (of dimension 30 mm x 15 mm x 3 mm) on the circumference of coupling of Motor for mounting of key phasor, there shall be space and provision in the assembled machine train for mounting the phase marker bracket supplied by BHEL. <i>(These details shall be confirmed with BHEL during detail engineering.)</i> 2.1.1.15.2 Interlock signal: - Belt filter wash tank level low. - Cake wash tank level low. 2.1.1.16 Lubricants & Consumables: All the first fill and one year's toppings requirements of consumables such as grease, oil, lubricants, servo fluids etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion to facilities should be provided by the supplier. Refer Clause 7.0 of this sub-section for details. 2.1.1.17 Suitable Painting and rust prevention during shipment and construction. 2.1.1.18 Seaworthy packing & forwarding to project site. Refer project information specified elsewhere in the specification. This is applicable where the equipment/component is coming through sea route. Otherwise, packing specification of equipment of Indian origin will be followed. 2.1.2 Services to be provided by the bidder: - Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL. - Supervision for Erection & Commissioning, trial run at site. - Performance guarantee tests at site & handover of the package in flawless condition to the customer. - training of customer/ client O&M staff covering all aspects of the GDWE- Operation & Maintenance (6 days) at Site.			



**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

GYP SUM DEWATERING EQUIPMENT

**TECHNICAL SPECIFICATION
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(v) Training of customer at manufacturer's works (6 man-days) including lodging and boarding

(vi) For supervision services, visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site. Bidder shall be informed around 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary.

2.1.3 Mandatory spares as defined as Annexure-II, Sub Section-D of Section I.

2.1.4 Recommended spare parts list to be furnished (not part of scope of supply)

2.1.5 Any other items required not covered above but required for the completeness of the equipment/system; it shall be included in the offer and shall be supplied by the Bidder/Supplier. Bidder shall refer to the P&IDs enclosed in Annexure-IV, Sub-Section-D of Section-I for the items under the bidder's scope. All the items indicated in the P&IDs are minimal requirements.

2.2 PROCESS DESCRIPTION	
1.	Common Gypsum Dewatering Equipment is envisaged for Stage I (3 x 200 MW) & Stage II (3 x 500 MW) units. The dewatering equipment shall receive the gypsum slurry from Primary Hydro cyclone feed pumps (BHEL Scope). Gypsum Dewatering Equipment shall be suitable for handling slurry from all the FGD absorber units. Two sets of primary hydrocyclone (1W+1S) with accessories shall be in bidder scope. Primary hydrocyclone underflow shall be taken to Vacuum Belt Filter (VBF) inlet.
2.	The overflow from the primary sets of hydro-cyclone shall be taken to a secondary hydro-cyclone feed tank (BHEL Scope). Secondary Hydro cyclone feed pumps (BHEL Scope) shall transfer the slurry from tanks to secondary hydro cyclone. Two sets of Secondary hydro cyclones (1 working + 1 stand by) and its accessories shall be in bidder scope.
3.	The underflow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water storage tank.
4.	Two nos. of belt filter wash tanks & Two nos. of cake wash tanks along with rubber lining (BHEL Scope) are envisaged for both the belt filters. Each tank shall be provided with 2 nos. of pumps of suitable requirement.

2.3 TERMINAL POINTS	
1.	Primary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of the primary hydro cyclone.
2.	Primary hydro cyclone overflow launder outlet flange. Further piping by BHEL to secondary hydrocyclone feed tank.
3.	Secondary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of secondary hydro cyclone.
4.	Secondary hydro cyclone underflow launder outlet flange and overflow launder outlet flange. Further piping by BHEL to waste water and filtrate tank.
5.	Outlet at filtrate extraction pumps discharge expansion joints and TP near VBF for other drain of such as cloth wash, dyke drain etc.
6.	Process/Clarified water & instrument air will be provided at one location, located at 5 m from GDW building boundary. Further piping from terminal point to GDW Equipment utilities are in bidder's scope.

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7.	Discharge of Gypsum through discharge chute onto the gypsum belt conveyor is in bidder's scope. Please refer enclosed P&IDs, typical layout & preliminary elevation drawing of GDWE building for the details in the scope.
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2.4 For Electrical scope, refer Electrical specification (Sub-section- C3, Section-I).

2.5 For Control & Instrumentation (C&I) scope, refer C&I specification (Sub-section- C4, Section-I).

3.0 CODES & STANDARDS AND OTHER REQUIREMENTS

3.1 The design and manufacturing of vacuum belt filter shall follow the latest applicable Indian / International (ASME / EN /Japanese) Standards.

3.2 The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code.

3.3 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 as well as of the locality where they will be installed, including the following:

- a) Indian Electricity Act
- b) Indian Electricity Rules
- c) Indian Explosives Act
- d) Indian Factories Act and State Factories Act
- e) Indian Boiler Regulations (IBR)
- f) Regulations of the Central Pollution Control Board, India
- g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- h) Pollution Control Regulations of Department of Environment, Government of India
- i) State Pollution Control Board.
- (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996
- (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
- (m.) Explosive Rules, 1983
- (n.) Petroleum Act, 1984
- (o.) Petroleum Rules, 1976,
- (p.) Gas Cylinder Rules, 1981
- (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
- (r.) Workmen's Compensation Act, 1923
- (s.) Workmen's Compensation Rules, 1924
- (t.) Safety Rules for Construction and Erection
- (u.) Safety Policy
- (v.) Any other statutory codes / standards / regulations, as may be applicable.

3.4 Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- a) Bureau of Indian standards (BIS)

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- b) Japanese Industrial Standards (JIS)
- c) American National Standards Institute (ANSI)
- d) American Society of Testing and Materials (ASTM)
- e) American Society of Mechanical Engineers (ASME)
- f) American Petroleum Institute (API)
- g) Standards of the Hydraulic Institute, U.S.A.
- h) International Organization for Standardization (ISO)
- i) Tubular Exchanger Manufacturer's Association (TEMA)
- j) American Welding Society (AWS)
- k) National Electrical Manufacturers Association (NEMA)
- l) National Fire Protection Association (NFPA)
- m) International Electro-Technical Commission (IEC)
- n) Expansion Joint Manufacturers Association (EJMA)
- o) Heat Exchange Institute (HEI)
- p) IEEE standard
- q) JEC standard

- 3.5 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 BHEL Customer'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.
- 3.6 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
- 3.7 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the BHEL 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 BHEL such changes and advise BHEL of the resulting effect.

4.0 DETAILED TECHNICAL SPECIFICATION	
4.1 DETAILED SPECIFICATION	
4.1.1	Bidder shall supply two stage Gypsum Dewatering Equipment consisting of primary hydro cyclones, vacuum belt filters (VBF) and secondary hydro cyclones for dewatering of gypsum from absorber(s) to less than 10% moisture at the design capacity specified elsewhere in the specification.
4.1.2	Bidder shall supply 2x100% Gypsum Dewatering Equipment with each stream sized to dewater 74.5 TPH (Wet cake) at outlet of VBF produced by the all FGD absorber units operating at design point. All other stipulations with respect to sizing and design of the dewatering Equipment, auxiliaries and other systems shall be in line with this specification.
4.2 Hydro-cyclones	
4.2.1	Two (2) sets of primary hydro cyclones are envisaged, each set shall be sized to dewater the gypsum slurry produced by the units operating at design point.

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4.2.2	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.
4.2.3	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant P&IDs.
4.2.4	Both primary and secondary hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
4.2.5	The hydro-cyclone shall be of proven design. The primary hydro-cyclone shall be made up of polyurethane or urethane materials. The feed chamber shall be provided with a minimum rubber lining thickness of 12 mm. The liners shall have a minimum wear life of not less than 7000 hours.
4.2.6	Two (2) sets of secondary hydro cyclones are to be installed. Each set of secondary hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
4.2.7	All Hydro Cyclones clusters shall be made of polyurethane or urethane material only.
4.3	Vacuum Belt Filters
4.3.1	Two (2) nos. of Vacuum Belt Filters each of capacity 74.5 TPH (wet cake) [≥ 67 TPH (dry)] at the outlet of each VBF are envisaged. Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: ▪ Outlet Moisture: 10% (maximum) ▪ Chloride content: 100 ppm (maximum) ▪ Gypsum Purity: 90% (minimum) – by BHEL
4.3.2	The Vacuum Belt Filters shall have the following characteristics: a) Very rigid frame and rolls, no deformation whatsoever may occur. b) All rolls shall be installed perfectly horizontally c) There shall be no vacuum under the slurry deposition zone. d) Deposit thickness control and directional stability control e) The slurry shall be put on the belt in counter current relative to the rotation of the band. f) The vacuum chambers shall be easily opened for inspection and cleaning.
4.3.3	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hours . In case the bidder does not stand guarantee for specified life, they shall supply additional sets of filter cloth(s) to meet the cumulative life of 7000 hours. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares.
4.3.4	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material. Accordingly, bidder may consider 'Corten / Weathering Steel'

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	or 'SS 304' or any other suitable corrosion resistant material conforming to ASTM A606-4, A588, A847 etc. as applicable. The material so selected, should be meeting the strength requirement of the belt filter.
4.3.5	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hours . In case the bidder does not stand guarantee for specified life, they shall supply additional sets of wear belt(s) to meet the cumulative life of 7000 hours. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares.
4.3.6	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
4.3.7	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the bidder's proven practice. The belt filter shall have an automatic cloth tensioning mechanism. Pull chord switches shall be provided for each vacuum belt filter. Four (04) no.'s of Belt sway switches shall be provided for each vacuum belt filter. Cake thickness sensors with double redundancy shall be provided for each vacuum belt filter which shall control the speed of the vacuum belt filter in turn.
4.3.8	Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump for each vacuum Belt filter. Flow indicator shall be provided for cloth washing line of each vacuum belt filter. Flow indicator shall be provided for cake washing line of each vacuum belt filter as per the relevant P&ID.
4.3.9	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. For cake washing only clarified water shall be used. One stage of cloth washing arrangement shall also be provided.
4.3.10	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
4.3.11	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. Hopper means discharge chute only, Gypsum cake from each belt filter shall be discharged through a chute arrangement onto belt conveyor indicated in GA drawing.
4.3.12	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance or it may provide a common platform of 3.3m (approx.) width. In case, common platform for VBF is provided, a movable platform along with access ladder shall be provided for approaching components on other side of VBF. The elevation of discharge point of vacuum belt filter shall be as per the Gypsum Dewatering Building Drawing provided in the Annexure-IV Sub Section-D of Section-I.
4.3.13	The service factor of the gear unit (if any) shall be minimum 1.5.
4.3.14	Piping and wiring within the skid shall be in the bidder's scope.
4.3.15	All client end connection flanges shall be ANSI B 16.5/AWWA.
4.4	Vacuum System
4.4.1	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice. Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt



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	filter operating at its maximum capacity. An additional 10% margin over the above shall be provided in each vacuum pump.
4.4.2	Each Vacuum pump shall have its own piping system, which connects the pump with the associated vacuum belt filter. Bidder to provide Equipment layout & General Arrangement (GA) of the Components in Gypsum dewatering building along with the offer.
4.4.3	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitation under all operating conditions. The seals shall be of proven design.
4.4.4	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.
4.4.5	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application and shall be subject to approval of BHEL/NTPL.
4.4.6	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.
4.4.7	The filtrate extraction pump shall be capable of pumping filtrate water with solid concentration of not less than 10% and particle lumps of 6-7 mm. A 10% margin shall be provided in each of the pump.
4.5	COMMON REQUIREMENTS FOR PUMPS (Vacuum, Filtrate Extraction, Cake/Cloth Wash)
4.5.1	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/ elastomer liners suitable for the fluid handled. The Bidder can also offer a hi-chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.
4.5.2	All the slurry pumps shall be provided with motorized suction and discharge valves. As per bidder's proven practice, pneumatic can be provided. In addition, flushing water lines with motorized/ pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder.
4.5.3	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy-duty ball/roller bearings.
4.5.4	All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions.
4.5.5	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
4.5.6	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1 m to the max NPSH required shall be provided.
4.5.7	All pumps shall be fitted with suction and discharge pressure gauges. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS 316 or equivalent.
4.5.8	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles.

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	Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.
4.5.9	Pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.
4.5.10	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be 115% of Best Efficiency Point (BEP).
4.5.11	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection of Duty point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising its NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and are at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.
4.5.12	External flushing is required to remove the accumulated particles and all related information should be mentioned in datasheet.
4.5.13	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.
4.5.14	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.
4.5.15	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start-up on overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
4.5.16	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built-in seal design will not be accepted.
4.5.17	The sealing areas shall be designed in such a way so that solids do not precipitate in them or affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
4.5.18	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
4.5.19	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
4.5.20	The material and thickness of the liners of slurry pumps (Filtrate Extraction pumps) shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hours.
4.5.21	Coupling halves shall be machine matched to ensure accurate alignment. Couplings must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
4.5.22	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling shall be of flexible type made of cast steel. The bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the pump and the motor by bidder. The coupling between shafts shall be so designed that they become tight during pump operation.

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4.5.23	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.
4.5.24	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, "Taper wedge" and the necessary fastener for Pump and Motor with Base plate.
4.5.25	Nameplate: All equipment shall be provided with name plates indicating the item number and service name. Nameplates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.
4.5.26	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
4.5.27	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
4.5.28	Skid Mount/ Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
4.5.29	Two pieces of stainless-steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
4.5.30	Provide double nuts for anchor bolts.
4.5.31	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
4.5.32	If the driver/ driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
4.5.33	Bidder shall provide the mating flanges with the necessary gaskets.
4.5.34	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
4.5.35	Bidder to provide capacity of crane or hoist required for safe material handling and the details of heaviest component to be handled.
4.5.36	Bidder to provide Pipe & Valve Material as per the Annexure-VIII, Sub-Section-D, Section-I of the Specification.
4.5.37	A 1000 mm wide platform with suitable approach shall be provided by the bidder for each hydro cyclone.
4.5.38	A 1500 mm space provision around all the pumps shall be provided by the bidder.
4.5.39	Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5 m height from the nearest platform. Below this height, a vertical ladder with minimum clear width of 600 mm may also be acceptable.
4.5.40	The list of all Bought out items with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted. Acceptance of makes shall be subject to BHEL's / Customer's acceptance during the detailed engineering without cost and delivery implication to BHEL.

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5.0 PIPING & INSTRUMENTATION DIAGRAMS (P&IDs)

The Piping and Instrumentation Diagram are enclosed in in Annexure-IV, Sub-Section-D, Section-I.

5.1 PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE - OPERATION POINT

Sl. No.	Parameters	Primary Hydro Cyclone Feed Slurry	Primary Hydro Cyclone Over Flow	Primary Hydro Cyclone Under Flow
a.	Total Flow (m ³ /hr.)	235.50	136.03 (*1)	99.45 (*1)
b.	Total Flow (t/hr.)	286.30	151.27 (*1)	134.95 (*1)
c.	Operating Temp (C)	61.4	61.4	61.4
d.	Design Temp (C)	70	70	70
e.	Solid (wt. %)	30	16.6 (*1)	> 45 (*2)
f.	Density (Kg/m ³)	1216	1112 (*1)	1357 (*1)
g.	pH	4-7	4-7	4-7
h.	Cl ⁻ (mg/l)	<26000	<26000	<26000

5.2 PROCESS PARAMETERS FOR SECONDARY HYDROCYCLONE - OPERATION POINT

Sl. No.	Parameters	Secondary Hydro cyclone – Feed Slurry	Secondary Hydro cyclone– Overflow	Secondary Hydro cyclone – Under flow
a.	Total flow (m ³ /hr)	136.03 (*1)	85.01 (*1)	51.02 (*1)
b.	Total flow (t/hr)	151.27 (*1)	86.97 (*1)	64.24 (*1)
c.	Operating Temp (°C)	61.4	61.4	61.4
d.	Design Temp (°C)	70	70	70
e.	Solid (% wt.)	16.6 (*1)	3 (*2)	35 (*1)
f.	Density (kg/m ³)	1112	1023	1257
g.	pH	4-7	4-7	4-7
h.	Cl ⁻ (mg/l)	<26000	<26000	<26000

5.3 DATA SHEET OF BELT FILTER - OPERATION POINT

Sl. No.	Parameters	Belt Filter Feed Slurry	Product Gypsum	Filtrate	Washing Water**
a.	Total Flow (m ³ /hr)	99.45 (*1)			
b.	Total Flow (t/hr)- Wet	134.95 (*1)	67.10		
c.	Design Temp (°C)	70.0			
d.	Solid (% wt.)	>45 (*2)	>90 (*2)	<0.2	
e.	Density kg/m ³	1355 (*1)			
f.	pH	4~7	5~8		
g.	Cl ⁻ (mg/l)	<26000	<100 ppm (*2)		
h.	Vacuum Belt filter and the peripherals shall be designed at 74.5 TPH (wet cake) discharge of product gypsum a. **Quantity of water shall be finalized by the vendor. Property of process water/ Clarified water) is given below. b. Hydro cyclone backpressure shall not exceed 20m L.C				
i.	(*1) shall be finalized by bidder. (*2) Shall be guaranteed by bidder.				

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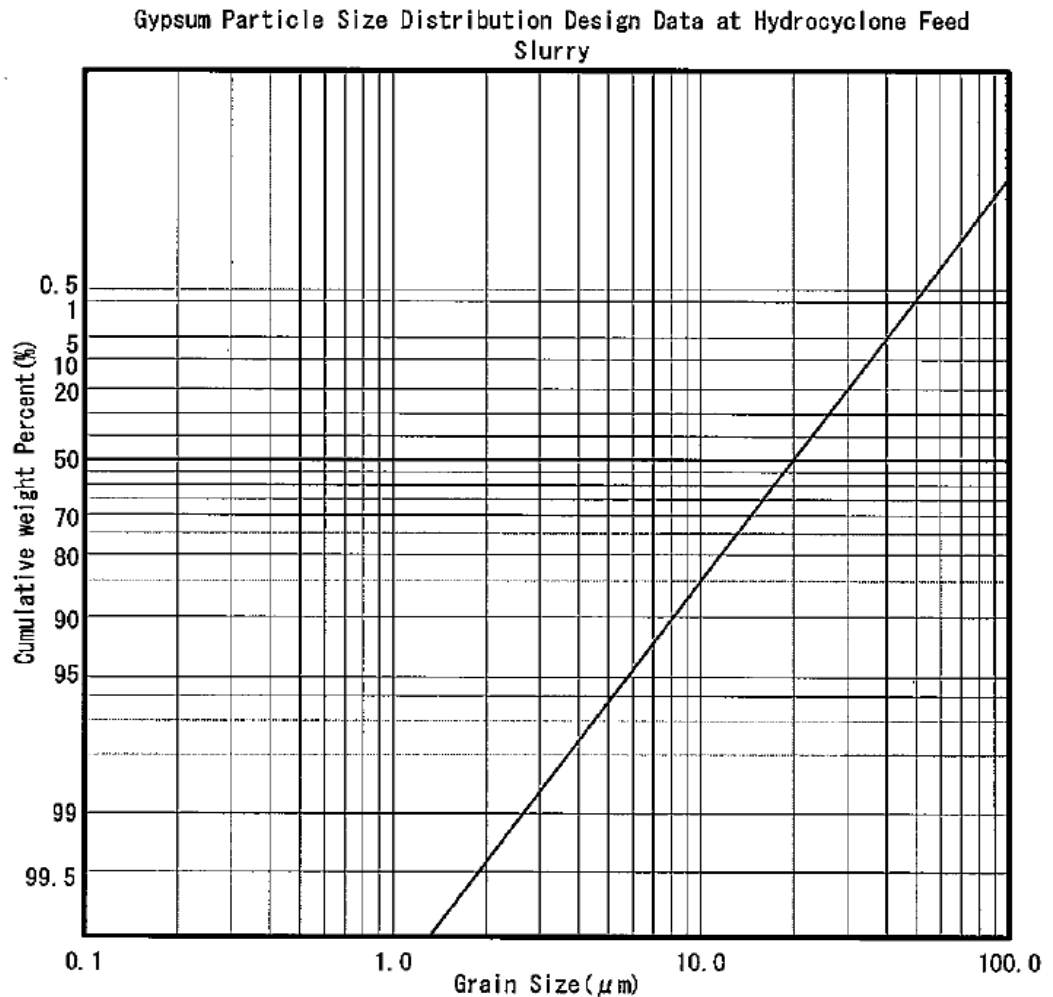
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5.4 GYPSUM PARTICLE SIZE AT HYDRO CYCLONE FEED SLURRY IS SHOWN BELOW:



Note:

1. Vendor to submit the PSD based on their design for PHC & SHC underflow and overflow
2. Gypsum particle size distribution (PSD) to be used for designing Hydrocyclones and Vacuum Belt Filter shall be as per the PSD curve provided in the tender specification. All guarantees of Gypsum dewatering Equipment performance shall be met by bidder as per the provided PSD only.

5.5 GYPSUM PARTICLE SIZE AT BELT FILTER FEED SLURRY:

Bidder to submit PSD graph design data at VBF inlet / PHC outlet.

5.6 DESIGN CONDITIONS OF PRIMARY & SECONDARY HYDRO CYCLONES:

1	Primary Hydrocyclone quantity	:	2 sets (1W+1SB)
2	Secondary Hydrocyclone quantity	:	2 sets (1W+1SB)
3	Primary Hydrocyclone capacity	:	260 m ³ /hr each
4	Secondary Hydrocyclone capacity	:	137 m ³ /hr each
5	Type of Hydrocyclone	:	Vertical
6	Material (MOC) of Cyclone Clusters	:	Polyurethane/Urethane
7	MOC of Feed Chamber	:	CS+12 mm rubber lining
8	MOC of Overflow Chamber	:	CS+12mm rubber lining
9	MOC of Underflow Chamber	:	CS+12mm rubber lining



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5.7 PROCESS WATER (USED FOR BELT WASHING) CHARACTERISTICS

5.7.1 CW BLOW DOWN WATER (FOR BELT WASHING):

CLARIFIED WATER ANALYSIS				
Sl. No.	Constituent	as	mg/ litre St-I	mg/Litre St-II
A) COOLING WATER ANALYSIS /CW BLOW DOWN WATER ANALYSIS				
1.	Calcium	CaCO ₃	237	316
2.	Magnesium	CaCO ₃	219	292
3.	Sodium	CaCO ₃	195	260
4.	Potassium	CaCO ₃	18	24
5.	Total Cations	CaCO ₃	669	892
6.	M-Alkalinity	CaCO ₃	120	120
7.	P-Alkalinity	CaCO ₃	0	0
8.	Nitrate CaCO ₃	CaCO ₃	6.6	8.8
9.	Chloride	CaCO ₃	189	252
10.	Sulphate	CaCO ₃	120	160
11.	Total Anions	CaCO ₃	669	892
12.	Silica	SiO ₂	45	60
13.	Iron	Fe	0.36	0.48
14.	pH Value	-	6.5-6.9	6.5-6.9
15.	Turbidity	NTU	4.5	6
16.	Total Dissolved solids	CaCO ₃	735	980
17.	Organic matter (Oxygen absorbed from Acid Permanganate In 4 Hrs.)	mg/l	0.1	0.1

Note : The C.W system is expected to operate at about 3 Cycles of Concentration for St-I and 4 cycles of concentration for St-II.

Note: Bidder to consider worst quality of process water as per above table for designing the Gypsum Dewatering Equipment.



NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)

GYP SUM DEWATERING EQUIPMENT

TECHNICAL SPECIFICATION
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-467-571-A901

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5.7.2 CLARIFIED WATER ANALYSIS (FOR CAKE WASHING): The chloride content is 45 ppm in the cake wash water.

Sl. No.	Constituent	as	mg/ litre St-I	mg/litre St-II
B) CLARIFIED WATER ANALYSIS				
1.	Calcium	CaCO ₃	79	79
2.	Magnesium	CaCO ₃	73	73
3.	Sodium	CaCO ₃	65	65
4.	Potassium	CaCO ₃	6	6
5.	Total Cations	CaCO ₃	223	223
6.	M-Alkanalinity	CaCO ₃	120	120
7.	P-Alkalinity	CaCO ₃	0	0
8.	Nitrate	CaCO ₃	2.2	2.2
9.	Chloride	CaCO ₃	63	63
10.	Sulphate	CaCO ₃	40	40
11.	Total Anions	CaCO ₃	223	223
12.	Silica reactive	SiO ₂	15	15
13.	Iron	Fe	0.12	0.12
14.	pH Value	-	6.5-6.9	6.5-6.9
15.	Turbidity	NTU	1.5	1.5
16.	Total Dissolved solids	CaCO ₃	245	245
17.	Organic matter (Oxygen absorbed from Acid Permanganate In 4 Hrs.)	mg/l	0.1	0.1

6.0 SPARES, TOOLS & TACKLES

6.1 START UP & COMMISSIONING SPARES

Start-up & Commissioning Spares shall be part of the main supply of the GDWE. Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares required for successful operation till commissioning of GDWE shall come under this category. Bidder shall provide an adequate stock of such start-up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at Site before the equipment's are energized. List shall be furnished by bidder along with bid as indicated at Section-III.

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYP SUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-467-571-A901	
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6.2	MANDATORY SPARES
	a) The list of mandatory spares considered essential by the BHEL's Customer/Employer is indicated in Annexure-II of Sub Section-D of Section-I in the specification. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidder's design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in their Bid. Whenever the quantity is mentioned in "sets", the bidder has to give the item details and prices of each item. b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. One set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. e) The Employer reserves the right to buy any or all the mandatory spare parts. f) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise. Bidder to provide the split up price for mandatory spares during placement of order as per price format.
6.3	RECOMMENDED SPARES:
	In addition to the spare parts mentioned above, the bidder shall also provide a list of recommended spares for 3 years of normal operation of the plant. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares.
6.4	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools. List shall be furnished by bidder along with bid as indicated at Section-III.

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYP SUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-467-571-A901	
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7.0	FIRST FILL OF CONSUMABLES
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7.1	Bidder's scope shall include supply and filling of all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
7.2	Bidder shall also supply a quantity not less than 10% of the full charge or One (1) year of topping requirement (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
7.3	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the Customer/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to a possible minimum. As far as possible lubricants marketed by the Indian Oil Corporation shall be used.

8.0	LIST OF REFERENCE DRAWINGS BY BHEL
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The drawings specified in Annexure-IV, Sub-Section-D, Section-I are being provided along with the tender specification for engineering, estimation and calculation purpose of the bidder.

9.0	PAINTS /PAINTING
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Bidder shall follow BHEL/ Customer painting philosophy specified in Sub-Section-C2-B, Section-I in the specification. Painting Schedule (Drawing No. 3130-109-PVM-H-001) is provided. However, for components where no specific requirement is stipulated, the bidder shall follow its standard practice suitable for operating condition subject to customer approval during detail engineering.

10.0	EXCLUSIONS
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Below are excluded from scope of the GDWE Supplier:

- All utilities such as instrument air and process water up to terminal point
- Control System (excluding Junction box)
- Lifting equipments for Material handling
- 3D Modeling
- Gypsum Conveyor from the discharge of chute.
- Tanks and their instruments & Slurry Pumps (except Filtrate Extraction)
- Vibration Monitoring System for HT motors.
- Civil work

11.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION – Refer Annexure-IV of Price Schedule
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Bidder is required to quote Guaranteed Power Consumption (GPC) in the price schedule format issued along with tender. In case of non-submission of filled up format, the bid shall be liable for rejection. Value for power consumption quoted by the bidder in the specified format, shall be considered as final and any request by bidder for any change in quoted power consumption at a later date, shall not be considered by BHEL.



NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)

GYP SUM DEWATERING EQUIPMENT

TECHNICAL SPECIFICATION
SPECIFIC TECHNICAL REQUIREMENT

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CUSTOMER SPECIFICATION

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYP SUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION PROJECT SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-467-571-A901	
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SECTION: I **SUB-SECTION: C 2A**

CUSTOMER SPECIFICATION

PROJECT SPECIFIC GENERAL REQUIREMENTS



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			
1.00.00	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS			
	GENERAL			
	The term “Performance Guarantees” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Functional Guarantees”. Similarly the term “Performance Tests” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Guarantee Test(s)”.			
	2.00.00 PERFORMANCE GUARANTEES / PERFORMANCE TESTS			
	2.01.00 General Requirements			
	2.01.01 The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.			
	2.01.02 The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.			
	2.01.03 The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.			
2.01.04 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.				
2.01.05 The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.				
2.01.06 It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.				
LOT-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 1 OF 30

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
2.02.00	Test Instrumentation, Flow Measurement and their Calibration			
2.02.01	All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost. The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.			
2.02.02	The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.			
2.02.03	The Contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following: (a) Object of the test. (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction calculations & curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments.			
LOT-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 2 OF 30

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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
3.00.00	Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis for unit capacity of 500 MW. For 200 MW / 210 MW units where common absorber has been specified for two / three units based on scope of supply, LD values are applicable for combination of units as indicated in the clause 3.00.00 The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. (ii) For Category-II Guarantees In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following: Reject the equipment /system / plant and recover from the Contractor the payments already made. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as "Category-II" Guarantees. AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.			
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 4 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC																
	<u>RAMAGUNDAM (3X500 MW)</u> <table><tr><th>Sl.No</th><th>Guarantee</th><th>Rate of Liquidated Damage (LD)</th><th>Acceptable Shortfall Limit with LD</th></tr><tr><td>i)</td><td> ~~SO₂ Removal Efficiency~~ ~~For shortfall in guaranteed SO₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section VI, Part A, Section VI.~~ </td><td> ~~INR 2,451,908 / (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.~~ </td><td> ~~(-)0.25% point from the guaranteed SO₂ removal efficiency.~~ </td></tr><tr><td>ii)</td><td> ~~Limestone Consumption~~ ~~For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section VI, Part A, Section VI.~~ </td><td> ~~INR 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.~~ </td><td> ~~(+)10% of the guaranteed limestone consumption.~~ </td></tr><tr><td>iii)</td><td> Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. </td><td> INR 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. </td><td> (+)1% of the guaranteed auxiliary power consumption </td></tr></table>				Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD	i)	~~SO₂ Removal Efficiency~~ ~~For shortfall in guaranteed 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
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																	
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 11 OF 30																

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC
	<u>RAMAGUNDAM St-II (3X200 MW) Common FGD system</u>			
	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	i)	~~SO₂ Removal Efficiency~~ ~~For shortfall in guaranteed SO₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section VI, Part A, Section VI.~~	~~INR 3,633,561/- (INR Three Million Six Hundred Thirty Three Thousand Five Hundred Sixty One only) for every 0.1% point shortfall in SO₂ removal efficiency from the guaranteed value.~~	~~(-)0.25% point from the guaranteed SO₂ removal efficiency.~~
	ii)	~~Limestone Consumption~~ ~~For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section VI, Part A, Section VI.~~	~~INR 20,812,843/- (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 BID DOC. NO.:CS-0011-109(3)-9		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
4.00.00 4.01.00	NOTES APPLICABLE FOR EACH PROJECT: i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable. ii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC) iii) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price. iv) The LD values are applicable on per unit basis 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 GUARANTEES PARAMETERS Guarantees Under Category-I The Performance Guarantees which attract Liquidated Damages (LD) are as follows: The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI: (i) ~~SO₂ removal Efficiency~~ ~~The Contractor shall guarantee that SO₂ removal efficiency shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.)~~ (ii) ~~Limestone Consumption~~ ~~The Contractor shall guarantee that limestone consumption of FGD system in kg/hr shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project).~~ (iii) Auxiliary Power Consumption The Contractor shall guarantee that total auxiliary power consumption for the unit in normal operation shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00			
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 21 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
4.02.00	Sub-section-V, Part-A of Section-VI applicable for complete scope of work for the respective project), inline with the requirements stipulated in clause 5.00.00 of this Sub-Section. Guarantees Under Category-II The parameters/capabilities shall be demonstrated for various systems/equipments shall include but not limited to the following:- (i) ~~Wet ball Mill capacity at rated fineness~~ ~~The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions:~~ i) ~~Limestone Output fineness :~~ ~~90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process)~~ ~~(OR)~~ ~~90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process)~~ ii) ~~Limestone Quality :~~ ~~All available quality from the specified range.~~ (ii) ~~Wet ball Mill wear parts guarantee~~ ~~Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation.~~ (iii) ~~Wet ball Mill ball consumption~~ ~~Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.~~ (iv) Vacuum Belt Filter Capacity Contractor shall demonstrate the Designed Capacity of the Vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification.			
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	

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	(v) Gypsum Purity The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for guarantee point condition. (vi) NOT USED ~~(vii) Performance characteristics of fans (capacity, head developed, etc.).~~ ~~(viii) Margins on fans in case Booster Fan is provided by the Contractor.~~ ~~Booster Fans - As specified in Part B of Technical Specifications~~ ~~(ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.~~ (x) Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. additional measurement points shall be considered based on the applicable standards and the size of the equipment. the measurement shall be done with slow response on the a - weighting scale. the average of a-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. corrections for background noise shall be considered in line with the applicable standards. all the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.			
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 23 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	(xi) ~~Mist Outlet Droplet Content~~ ~~The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20 mg/Nm³ at absorber outlet measured over a period of 24 hrs continuous operation.~~ ~~Mist outlet droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.~~ (xii) ~~Availability of FGD Plant~~ ~~The Contractor shall guarantee the maximum availability of FGD Plant for the range of coal and limestone specified inline with the requirements stipulated in clause 7.00.00 of this Sub Section~~ (xiii) ~~Air Conditioning System~~ ~~A. Following shall be demonstrated at Shop~~ ~~1) Capacity and static pressure of AHU fans at its rated duty point.~~ ~~B. Following shall be demonstrated at Site~~ ~~1) Capacity (TR) of air cooled condensing units (D X type) for A/C system of FGD control room building.~~ ~~2) Guaranteed room conditions during summer for all the Air conditioned areas.~~ ~~3) Vibration and noise level of condensing units & centrifugal fans of AHUs.~~ (xiv) ~~Ventilation System~~ ~~A. Following shall be demonstrated at Shop~~ ~~1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.~~ ~~2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.~~ ~~B. Following shall be demonstrated at Site~~ ~~1) Vibration & Noise level of centrifugal fans & pumps of UAF units.~~ (xv) ~~Compressed Air System~~ ~~a) Following shall be demonstrated at shop:~~ ~~i) Capacity and discharge pressure of each air compressor.~~ ~~b) Following shall be demonstrated at site:~~ ~~ii) Dew point of air at the outlet of air drying plants of air compressor.~~			
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 24 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
5.00.00	iv) ~~Pressure drop across air drying plant.~~ v) ~~Vibration and noise level of air compressors, blowers of air drying plant (if applicable)~~ (xvi) ~~Equipment Cooling Water System~~ i) ~~Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site.~~ ii) ~~Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.~~ (xvii) ~~Limestone Handling System and Gypsum Handling System~~ a) ~~Limestone Handling Plant~~ (i) ~~The Bidder shall demonstrate the unloading at truck tippler, crushing and conveying to storage shed/silo and then reclaim from storage shed/silos and conveying to mill bunker at the guaranteed capacity including all intermediate equipment & conveyors.~~ (ii) ~~Bidder shall also demonstrate the guaranteed tipping rate of truck tipplers.~~ b) ~~Gypsum Handling Plant~~ ~~The Bidder shall demonstrate the guaranteed conveying from belt filter to storage shed/silo including all intermediate equipment & conveyors.~~			
	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT The unit auxiliary power consumption shall be calculated using the following relationship. P_a = $(P_{a1} + P_{a2} + ... + P_{an})/n$ P_{an} = $P_{un} + T_{Ln}$ P_a = Guaranteed Auxiliary Power Consumption P_{an} = Auxiliary Power Consumption for unit # n (Where “n” is the unit number e.g. 1, 2, ...)			
	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 25 OF 30

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	P_{un} = Power consumed by the auxiliaries of the unit under test T_{Ln} = Losses of the transformers supplied by bidder based on works test reports While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following: i. ~~Absorber Recirculation Pump(s)/Gas Cooling Pumps~~ ii. ~~Absorber Oxidation Air Blower(s)~~ iii. ~~Absorber Oxidation Tank Agitators~~ iv. ~~Gypsum Bleed Pumps~~ v. ~~Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project~~ vi. ~~Limestone Slurry Pump(s)~~ vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project including Filtrate Extraction Pump After Vacuum Receiver, Vent Fan & Sump Pump 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~~			
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 26 OF 30	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	~~of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system divided by the number of units (working) in the project~~ ~~xv. Booster Fans~~ ~~xvi. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project~~ ~~xvii. Power consumption of Filtrate Pump(s) divided by the number of units in the project~~ xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project ~~xix. Power consumption of Hydro cyclone and Waste Water Pump divided by the number of units in the project~~ ~~xx. Power consumption of all other continuous running Agitators divided by the number of units in the project~~ ~~xxi. Air Conditioning System (*)~~ ~~Total Power consumption at motor input terminals of working units (i.e. excluding stand by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project~~ ~~xxii. Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)~~ ~~((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)~~ ~~xxiii. Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project.~~ ~~xxiv. Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Singrauli STPP-I & II (5X200MW) & (2X500MW).~~ ~~xxv. Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Farakka STPP-I (3X200MW).~~ ~~xxvi. Power consumption of clarified Water Pumps at rated capacity and head divided by the no of units of the project for Farakka STPP-II (2X500MW).~~ ~~xxvii. 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).~~			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
6.00.00	~~xxvii) Air Conditioning System (*)~~ ~~Total Power consumption at motor input terminals of working units (i.e. excluding stand by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project..~~ ~~xxviii) Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)~~ ~~((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)~~ ~~xxix) Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project~~ NOTE: - 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. METHOD OF COMPUTING TEST EFFICIENCY OF FGD ~~The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the~~			
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	

AMENDMENT NO. 7 TO TECHNICAL SPECIFICATION

S. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.		
19.	Part-A	SUB- SEC- TION- V	2 of 23	5.00.00	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT $P_a = (Pa1 + Pa2 + \dots + P_{an})/n$ $P_{an} = P_{un} + T_{Ln}$ P_a = Guaranteed Auxiliary Power Consumption P_{an} = Auxiliary Power Consumption for unit # n (Where "n" is the unit number e.g. 1, 2, ...) P_{un} = Power consumed by the auxiliaries of the unit under test T_{Ln} = Losses of the transformers supplied by bidder based on works test reports.	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT $P_{an} = P_{un} + T_{Lu}$ P_{an} = Guaranteed Auxiliary Power Consumption for unit # n (Where "n" is the unit number e.g. 1, 2, ...) P_{un} = Power consumed by the auxiliaries of the unit under test T_{Lu} = Proportional Losses of transformers for one Unit/Block T_L = Losses of all the transformers supplied by bidder based on works test Reports T_{Lu} shall be calculated as below: $T_{Lu} = (T_L / \text{Total MW capacity under the present contract}) \times (\text{capacity in MW for FGD (unit/block) under test})$

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

FGD SYSTEM PACKAGE LOT-3 PROJECTS	AMENDMENT NO. CS-0011-109(3)-9-AMDT-TECH-07 BID DOCUMENT NO. CS-0011-109(3)-9	Page 8 of 8
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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

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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

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

GENERAL TECHNICAL REQUIREMENTS

PART - C

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1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.		
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.		
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.		
4.00.00	COMPLETENESS OF FACILITIES		
4.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.		
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.		
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4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	RULES, REGULATIONS, CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following: a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976,			
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5.02.00	(p.)	Gas Cylinder Rules, 1981		
	(q.)	Static and Mobile Pressure Vessels (Unified) Rules, 1981		
	(r.)	Workmen's Compensation Act, 1923		
	(s.)	Workmen's Compensation Rules, 1924		
	(t.)	NTPC Safety Rules for Construction and Erection		
	(u.)	NTPC Safety Policy		
	(v.)	Any other statutory codes / standards / regulations, as may be applicable.		
	Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:			
	a)	Bureau of Indian standards (BIS)		
	b)	Japanese Industrial Standards (JIS)		
	c)	American National Standards Institute (ANSI)		
	d)	American Society of Testing and Materials (ASTM)		
	e)	American Society of Mechanical Engineers (ASME)		
	f)	American Petroleum Institute (API)		
	g)	Standards of the Hydraulic Institute, U.S.A.		
	h)	International Organisation for Standardisation (ISO)		
	i)	Tubular Exchanger Manufacturer's Association (TEMA)		
	j)	American Welding Society (AWS)		
	k)	National Electrical Manufacturers Association (NEMA)		
	l)	National Fire Protection Association (NFPA)		
m)	International Electro-Technical Commission (IEC)/European Norm (EN)			
n)	Expansion Joint Manufacturers Association (EJMA)			
o)	Heat Exchange Institute (HEI)			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	p) IEEE standard q) JEC standard			
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.			
5.04.00	Not used.			
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.			
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.			
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.			
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.			
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE			
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
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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			
	engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.			
8.02.00	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification.			
8.03.00	The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:			
8.03.01	A) BASIC ENGINEERING DOCUMENTATION Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.			
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	vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope. 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. 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. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. 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. B) DETAILED ENGINEERING DOCUMENTS i) General layout plan of the FGD System. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, process and instrumentation diagrams along with write up and system description. iv) Performance curves for Absorber v) Piping isometric, composite layout and fabrication drawings. vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules. 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. 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. ix) Absorber sizing calculations. Absorber performance data.			
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	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 diagramsand 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			
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8.03.02	scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. xxvii) Underground facilities, levelling, sanitary, land scaping drawings. xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance. The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.			
	INSTRUCTION MANUALS The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection.			
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	c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows: 1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied a) Description of operating principle of equipment / system with schematic drawing / layouts.			
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	(b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided. (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures.			
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	(i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc. (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at			
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	longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.			
8.03.03	After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.			
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT			
8.03.03.01	PLANT HANDBOOK			
	The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams.			
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8.03.03.02	iv) Sequence & Protection Interlock Schemes. v) Alarm and trip values. vi) Performance Curves. vii) General layout plan and layout of main plant building and auxiliary buildings viii) Important Do's & Don't's The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.				
	PROJECT COMPLETION REPORT The Contractor shall submit a Project Completion Report at the time of handing over the plant.				
8.03.04	DRAWINGS a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check. ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C. iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all				
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	facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference. Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.			
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	The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.			
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	Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per Annexure VI. k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule. m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing. n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.			
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8.04.00	ENGINEERING INFORMATION SUBMISSION SCHEDULE Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.		
8.05.00	ENGINEERING PROGRESS AND EXCEPTION REPORT		
8.05.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.		
8.05.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.		
8.06.00	Engineering Co-ordination Procedure		
8.06.01	The following principal coordinators will be identified by respective organizations at time of award of contract: NTPC Engineering Coordinator (NTPC EC):		
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	Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE :			
8.06.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.			
8.06.03	Contractor's/Vendor's Drawing Submission and Approval Procedure: a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering. c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.			
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	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. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer’s scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer’s review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records. h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number			
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	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. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
9.00.00	TECHNICAL CO-ORDINATION MEETING			
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.			
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The			
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	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.			
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
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13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container.			
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.			
14.00.00	LUBRICATION			
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.			
15.00.00	MATERIAL OF CONSTRUCTION			
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.			
16.00.00	RATING PLATES, NAME PLATES & LABELS			
16.01.00	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.			
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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	Safety and relief valves shall be provided with the following: - Manufacturer's identification. - Nominal inlet and outlet sizes in mm. - Set pressure in Kg/cm² (abs). - Blowdown and accumulation as percentage of set pressure. - Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
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17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for			
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20.02.00	painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification. PRESERVATIVE SHOP COATING All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.			
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.			
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.			
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.			
20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.			
21.00.00	QUALITY ASSURANCE PROGRAMME			
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A			
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	quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of			
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	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.			
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.			
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.			
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP)			
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	and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).			
22.08.00	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			
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.			
22.10.00	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.			
22.11.00	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.			
22.12.00	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			
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
22.14.00	No welding shall be carried out on cast iron components for repair.			
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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	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. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.			
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.			
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the			
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	monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.			
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.			
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.			
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.			
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.			
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.			
22.24.00	Environmental Stress Screening Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.			
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.			
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22.26.00	Software Reliability / Quality Certification Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.			
23.00.00	QUALITY ASSURANCE DOCUMENTS			
23.01.00	The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.			
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.			
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.			
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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	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (a.) Interpretation of all the terms and conditions of these documents and specifications (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain			
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	for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.			
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.			
25.05.00	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.			
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.			
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.			
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25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.			
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.			
25.10.00	Associated document for Quality Assurance programme			
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.			
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.			
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).			
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.			
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.			
25.11.00	Not Used			
25.12.00	DEMONSTRATION OF APPLICATION ENGINEERING			
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation.			
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	e)	Master slave implementation with different slave combination.			
	f)	Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.			
	(ii)	HMI Functions:			
	a)	LVS Annunciation.			
	b)	Graphics.			
	c)	HSR			
	d)	Logs/Reports.			
	e)	Calculations (Basic & Performance Calculations).			
	25.12.02	The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
	25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES				
26.01.00	(a)	As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.			
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	(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. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(standard check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.			
26.01.00	Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least twelve months prior to the schedule date of commissioning of 1st unit. The chart should contain: (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.			
26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during			
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26.03.00	which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours. The Initial Operation shall be considered successful, provided that each item/part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. (c) Any operational interruption in the FGD System due to constraints attributable to the Employer shall be construed as Deemed to be in operation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission. Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with the Initial Operations.			
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	b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.			
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.			
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL			
28.01.00	Training for Employers O&M Personnel The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance. Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.			
28.02.00	Training for Employers Engineering Personnel The scope of services under training for Employer's engineering personnel shall also necessarily include three (3) man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like			
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	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.			
28.03.00	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above (i.e. 6 man months and 3 man months respectively for O&M and Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
28.04.00	Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.			
28.05.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.			
28.06.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.			
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
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30.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable: a) Ball Mill < 90 dBA			
31.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.			
32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES			
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.			
33.00.00	INSTRUMENTATION AND CONTROL All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.			
33.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows: 1 Temperature - Degree centigrade (deg C)			
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	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.		
	3. Draught	- Millimetres of water column (mm wc).		
	4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).		
	5. Flow (Gas)	- Tonnes/ hour		
	6. Flow (Steam)	- Tonnes/ hour		
	7. Flow (Liquid)	- Tonnes / hour		
	8. Flow base	- 760 mm Hg. 0 deg.C		
	9. Density	- Grams per cubic centimeter.		
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.			
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.			
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).			
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35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.			
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. 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.			
37.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets			
38.00.00	SYSTEM DOCUMENTATION The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I			
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	"Techncial Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage. 38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer. 39.00.00 MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and 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.			
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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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IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963		
IS:3354	Outline dimensions for electric lifts.			
IS:3401	Silica gel			
IS:3588	Specification for electrical axial flow fans			
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diameter)			
IS:3677	Unbonded rock and slag wool for thermal insulation			
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)		
IS:3895	Specification for monocrystalline semiconductor rectifier cells and stacks			
IS:3963	Roof extractor unit			
IS:3975	Mild steel wires, strips and tapes for armouring cables			
IS:4503	Shell and tube type heat Exchanger			
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	IS:4540 IS:4671 IS:4736 IS:4894 IS:5456 IS:5749 IS:6392 IS:6524 Part-I IS:7098 IS:7373 IS:7938 ISO:1217 ASHRAE-33 and air heating coils. ASHRAE-52-76	Specification for monory- stallines rectifire assembly equipment Expanded polystyrene for thermal insulation purpose Hot dip zinc coating on steel tubes Centrifugal fans Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only) Forged ramshorn hooks Steel pipe flanges Code of practice for design of tower cranes Static and rail mounted Cross linked Polyethylene insulated PVC sheathed cables Specification for wrought aluminium and aluminium sheet and strips Air receivers for compressed air installation Displacement compressor-Acceptance test Methods of testing for rating of forced circulation air cooling Air cleaning device used in general ventilation for removing particle matter.	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958 BS 4504 : 1969 BS 2799 : 1956 Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
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	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.			
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	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.		
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	(Part-II)	Calcined clay based.		
	IS: 1542	Specification for sand for plaster.		
	IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.		
	IS: 1786	Specification for high strength deformed bars for concrete reinforcement.		
	IS: 2062	Specification for steel for general structural purposes.		
	IS: 2116	Specification for sand for masonry mortars.		
	IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.		
	IS: 3150	Hexagonal wire netting for general purpose.		
	IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.		
	IS: 3812	Specification for fly ash, for use as pozzolana and admixture.		
	IS: 4031	Methods of physical tests for hydraulic cement.		
	IS: 4032	Methods of chemical analysis of hydraulic cement.		
	IS: 4082	Recommendations on stacking and storage of construction materials at site.		
	IS: 8112	Specification for 43 grade ordinary portland cement.		
	IS: 8500	Medium and high strength structural steel.		
	IS: 12269	53 grade ordinary portland cement.		
	IS: 12894	Specification for Fly ash lime bricks.		
	Cast-In-Situ Concrete and Allied Works			
	IS: 280	Specification for mild steel wire for general engineering purposes.		
	IS: 456	Code of practice for plain and reinforced concrete.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 457 IS: 516 IS: 650 IS: 1199 IS: 1791 IS: 1838 (Part-I) IS: 2204 IS: 2210 IS: 2438 IS: 2502 IS: 2505 IS: 2506 IS: 2514 IS: 2645 IS: 2722 IS: 2750 IS: 2751 IS: 3025 IS: 3366 IS: 3370	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. Method of test for strength of concrete. Specification for standard sand for testing of cement. Methods of sampling and analysis of concrete. General requirements for batch type concrete mixers. Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). Code of practice for construction of reinforced concrete shell roof. Criteria for the design of reinforced concrete shell structures and folded plates. Specification for roller pan mixer. Code of practice for bending and fixing of bars for concrete reinforcement. General requirements for concrete vibrators, immersion type. General requirements for concrete vibrators, screed board type. Specification for concrete vibrating tables. Specification for Integral cement water proofing compounds. Specification for portable swing weigh batches for concrete. (single and double bucket type) Specification for Steel scaffolding. Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. Methods of sampling and test waste water. Specification for Pan vibrators. Code of practice for concrete structures for the storage of	
LOT-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 53 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction of buildings. Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete work. Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.	
LOT-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		
	IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.	
	IS: 10262	Recommended guidelines for concrete mix design.	
	IS: 11384	Code of practice for composite construction in structural steel and concrete.	
	IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.	
	IS: 12118	Specification for two-parts poly sulphide.	
	IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.	
	IS: 13311	Method of non-destructive testing of concrete.	
	Part-1	Ultrasonic pulse velocity.	
	Part-2	Rebound hammer.	
	SP:23	Handbook of concrete mixes	
	SP: 24	Explanatory Handbook on IS: 456-1978	
	SP: 34	Handbook on concrete reinforcement and detailing.	
	Precast Concrete Works		
	SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) systems building.	
	IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.	
	IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.	
	Masonry and Allied Works		
	IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.	
	IS: 2212	Code of Practice for Brickwork.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting 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 		
	IS: 814 IS: 1852 IS: 3502 IS: 6911 IS: 3757 IS: 6623 IS: 6649 IS: 800 IS: 816 IS: 4000 IS: 9595 IS: 817 IS: 1811 IS: 9178 IS: 9006 IS: 7215 IS: 12843 IS: 4353 SP: 6 (Part 1 to 7)	Specification for covered Electrodes for Metal Arc Welding for weld steel. Specification for Rolling and Cutting Tolerances for Hot rolled steel products. Specifications for chequered plate. Specification for stainless steel plate, sheet and strip. Specification for high strength structural bolts Specification for high strength structural nuts. High Tensile friction grip washers. Code of practice for use of structural steel in general building construction. Code of practice for use of Metal Arc Welding for General Construction. Code of practice for assembly of structural joints using high tensile friction grip fasteners. Code of procedure of Manual Metal Arc Welding of Mild Steel. Code of practice for Training and Testing of Metal Arc Welders. Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). Criteria for Design of steel bins for storage of Bulk Materials. Recommended Practice for Welding of Clad Steel. Tolerances for fabrication steel structures. Tolerance for erection of structural steel. Recommendations for submerged arc welding of mild steel and low alloy steels. ISI Hand book for structural Engineers.	
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 57 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds.	
	Plastering and Allied Works IS : 1635 IS : 1661 IS : 2333 IS : 2402 IS : 2547 IS : 3150	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.	
	Acid and Alkali Resistant Lining IS : 158 IS : 412	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 Water Supply, Drainage and Sanitation IS : 458 IS : 554 IS : 651 IS : 774 IS : 775 IS : 778 IS : 781 IS : 782 IS : 783	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. 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
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS : 1172 IS : 1230 IS : 1239 IS : 1536 IS : 1537 IS : 1538 IS : 1703 IS : 1726 IS : 1729 IS : 1742 IS : 1795 IS : 1879 IS : 2064 IS : 2065 IS : 2326 IS : 2470 (Part-I & II) IS : 2501 IS : 2548 IS : 2556 (Part 1 to 15) IS : 2963	Basic requirements for water supply, drainage and sanitation. Cast iron rain water pipes and fittings. Mild steel tubes, tubulars and other wrought steel fittings. Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. Vertically cast iron pressure pipes for water, gas and sewage. Cast iron fittings for pressure pipe for water, gas and sewage. Ball valves (horizontal plunger type) including float for water supply purposes. Cast iron manhole covers and frames. Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. Code of practice for building drainage. Pillar taps for water supply purposes. Malleable cast iron pipe fittings. Code of practice for selection, installation and maintenance of sanitary appliances. Code of practice for water supply in building. Automatic flushing cisterns for urinals. Code of practice for installation of septic tanks. Copper tubes for general engineering purposes. Plastic seat and cover for water-closets. Vitreous sanitary appliances (vitreous china). Non-ferrous waste fittings for wash basins and sinks.	
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 60 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS : 3114	Code of practice for laying of cast iron pipes.	
	IS : 3311	Waste plug and its accessories for sinks and wash basins.	
	IS : 3438	Silvered glass mirrors for general purposes.	
	IS : 3486	Cast iron spigot and socket drain pipes.	
	IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).	
	IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.	
	IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.	
	IS : 4127	Code of practice for laying of glazed stone-ware pipes.	
	IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.	
	IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.	
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.	
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.	
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.	
	IS : 5961	Cast iron grating for drainage purpose.	
	IS : 7740	Code of practice for road gullies.	
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.	
	IS : 8934	Cast copper alloy fancy pillar taps for water services.	
	IS : 9762	Polyethylene floats for ball valves.	
	IS : 10446	Glossary of terms for water supply and sanitation.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS : 10592 IS : 12592 IS : 12701 SP: 35 - Doors, Windows and Allied Works IS : 204 Part-I Part-II IS : 208 IS : 281 IS : 362 IS : 420 IS : 1003 Part-I door IS : 1038 IS : 1081 IS : 1341 IS : 1361 IS : 1823 IS : 1868 IS : 2202 (Part-II)	Industrial emergency showers, eye and face fountains and combination units. Specification for precast concrete manhole covers and frames. Rotational moulded polyethylene water storage tanks. Hand book on water supply and drainage. Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated. Tower Bolts Ferrous metals. Nonferrous metals. Door Handles. Mild steel sliding door bolts for use with padlocks. Parliament Hinges. Specification for putty, for use on metal frames. Specification for timber panelled and glazed shutters- (Part-I) shutters. Steel doors, windows and ventilators. Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. Steel butt hinges. Steel windows for industrial buildings. Floor door stoppers. Anodic coatings on Aluminium and its alloys. Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels	
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 62 OF 83

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		
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
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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			
	IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.		
	Part-I	Shallow foundations.		
	Part-II	Deep foundations.		
	IS:12070	Code of practice for design and construction of shallow foundations on rocks.		
	DIN:4024	Flexible supporting structures for machines with rotating machines.		
	VDI:2056	Criteria for assessing mechanical vibrations of machines.		
	VDI:2060	Criteria for assessing rotating imbalances in machines.		
	Stop Log and Trash Rack			
	IS:4622	Recommendations for fixed - wheel gates structural design.		
	IS:5620	Recommendations for structural design criteria for low head slide gates.		
	IS:11388	Recommendations for design of trash rack for intakes.		
	IS:11855	General requirements for rubber seals for hydraulic gates.		
	Roads			
	IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.		
	IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.		
	IRC:16	Specification for priming of base course with bituminous primers.		
	IRC:19	Standard specifications and code of practice for water bound macadam.		
	IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).		
	IRC:34	Recommendations for road construction in waterlogged areas.		
	IRC:36	Recommended practice for the construction of earth embankments for road works.		
	IRC:37	Guidelines for the Design of flexible pavements.		
	IRC:56	Recommended practice for treatment of embankment slopes for erosion control.		
	IRC:73	Geometric design standards for rural (non-urban) highways.		
	IRC:86	Geometric Design standards for urban roads in plains.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IRC:SP:13	Guidelines for the design of small bridges & culverts.	
	IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.	
	IS:73	Specification for paving bitumen	
	Loadings		
	IS:875	Code of practice for design loads other than earthquake) for	
	(Pt. I to V)	buildings and structures.	
	IS:1893	Criteria for earthquake resistant design of structures.	
	IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.	
	IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.	
	M.O.T.	Deptt. of railways Bridge Rules.	
	Safety		
	IS:3696	Safety code for scaffolds and ladders.	
	(Part I & II)		
	IS:3764	Safety code for excavation work.	
	IS:4081	Safety code for blasting and related drilling operations.	
	IS:4130	Safety code for demolition of buildings.	
	IS:5121	Safety code for piling and other deep foundations.	
	IS:5916	Safety code for construction involving use of hot bituminous materials.	
	IS:7205	Safety code for erection on structural steelwork.	
	IS:7293	Safety code for working with construction machinery.	
	IS:7969	Safety code for handling and storage of building materials	
	IS:11769	Guidelines for safe use of products containing asbestos.	
	- Indian Explosives Act. 1940 as updated.		
	Architectural design of buildings		
	SP:7	National Building Code of India	
	SP:41	Hand book on functional requirements of buildings (other than industrial buildings)	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Creteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication			
LOT-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 68 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements 1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). 2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. 3. Temperature measurement by electrical Resistance thermometers - IS:2806. 4. Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements 1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). b) Electronic transmitters BS:6447. 2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. 3. Process operated switch devices (Pr. Switch) BS-6134. Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software 1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. 2. Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. 3. Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	4. Dynamic response testing of process control instrumentation ISA - S 26 (1968). 5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. 6. Printed circuit boards - IPC TM - 650, IEC 326 C. 7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. 8. Edge socket connectors - IEC 130-11. 9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. 10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). 11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R). 12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. 13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. 14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. 15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988. 16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.			
LOT-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 70 OF 83

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

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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	5. Control Valve leak class - ISA RP 39.6 Process Connection & Piping 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. Instrument Tubing 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11. 4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables 1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. 2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. 3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83. 4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). 5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. 6. Rules for Testing insulated cables and flexible cables : VVDE - 0472			
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 73 OF 83

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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732 9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II) 10. Fittings for rigid steel conduits for electrical wiring - IS:2667 11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147. Vibration Monitoring System 1. API 670 - 1994 2. BS : 4675 Part-2			
LOT-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 75 OF 83

ANNEXURE-I

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

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

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

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

1/1

ENGG. DIV./QA&I

LOT-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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ANNEXURE-II

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

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

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

FORMAT NO.: QS-01-QAI-P-09/F2-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 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 :		SUB-SYSTEM :					DATE :		
	Contractor No. :							PAGE : OF		
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”

QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

FORMAT NO.: QS-01-QAI-P-1/F3-R0

1/1

Engg. Div. / QA&I

LOT-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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THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

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/III/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT						1/1		Engg. Div. / QA&I			

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

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

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Contractor :				(To be raised by the contractor)							REV. NO.:			
		Contractor No. :				Welding Code:							DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT						1/1						Engg. Div. / QA&I				

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

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) ■ Other Drawings/Documents (A0&A1 sizes) ■ P&ID (All sizes) a) Final drawings/documents (Directly to site) b) "As Built" Drawing/Documents (Directly to site) c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	4 2 4 6 6 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

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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 REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
FGD	Layout & model of FGD area, cable & piping trestles etc. FGD • 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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Introduction to the Quality Assurance Specification:

For fulfilment of the relevant clauses (regarding Testing, Inspection etc.) of the General Conditions of Contract and General Technical Requirements of Contract, the Quality Assurance Specification acts as a part of the Technical Specification and is included in the Contract.

This part of the Technical Specification shall be read in conjunction with other parts of the technical specifications, General Technical Requirements and Erection Conditions of the Contract.

This document specifies the quality requirements, to be detailed in terms of Tests/Checks/Procedures to be followed at the times of manufacturing, Testing, Inspection and also during installation of various Equipment / Components at the place of manufacturer and / or on the site.

Various standards referred in this document shall be the latest revisions.

The quality requirements are spelt out in the following ways;

- 1) Through description
- 2) In tabular form

In either of the above two formats the tests /checks / procedures that are required to be performed are mentioned against particular item/ equipment/ component/ system etc.

This specification also contains the Indicative vendor list (with disclaimer) mentioned against particular item/ equipment/ component/ system etc.

The quality requirements specified in this document and also the vendor list are only indicative and not exhaustive.

SUB-SECTION-V-QM1

FLUE GAS DESULPHURISATION SYSTEM

To be read along with Section I-Sub Section D - Annexure III
(INSPECTION AND TESTING)

CLAUSE NO.	QUALITY ASSURANCE			Page 166 of 550
	एनटीपीसी NTPC			
	FLUE GAS DESULPHURISATION SYSTEM			
1.00.0	FLUE GAS DESULPHURISATION SYSTEM			
1.01.0	Mills:			
1.01.01	~~Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.~~			
1.01.02	~~Wear resistant parts shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.~~			
1.01.03	~~Butt welds in the tube/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.~~			
1.01.04	~~All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.~~			
1.02.0	Feeders:			
1.02.01	~~Any welds in the casing/pulley fabrication shall be checked with MPI.~~			
1.02.02	~~Routine tests shall be done~~ as per relevant Indian Standards or equivalent International Standards.			
1.02.03	~~All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.~~			
1.02.04	~~Calibration check shall be carried out on all feeders.~~			
1.03.0	Dampers:			
1.03.01	~~All the dampers shall be subjected to operational test/checks.~~			
1.03.02	~~Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness as per NTPC Tech Specification.~~			
1.04.0	PIPING, VALVE AND SPECIALITIES:			
1.04.01	All pipes and fittings shall be tested as per applicable code.			
1.04.02	All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.			
1.04.03	NDT on valves shall be as per relevant standard.			
1.04.04	Valves shall be offered for hydro test in unpainted conditions.			
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	PART-B SUB-SECTION-V-QM1 FGD SYSTEM	Page 1 of 4

CLAUSE NO.	QUALITY ASSURANCE
1.05.00	TANKS / VESSELS:
1.05.01	Atmospheric tanks:
	i) ~~All welds joints shall be DP tested and complete tanks shall be water fill tested.~~ ii) ~~All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.~~ iii) ~~Rubber lining shall be tested for hardness and spark test, as applicable.~~
1.05.02	Pressure vessels:
	1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below: i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds. ii) 10% DPT on all finished butt welds. iii) 10% RT (covering all 'T'/cross joints) of butt welds. 2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT. 3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.
1.06.00	HEAT EXCHANGER/HEATER:
1.06.01	~~All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.~~
1.06.02	~~NDT on welds and other checks shall be as per relevant code.~~
1.06.03	~~Air heaters shall be subjected to dimensional and clearance checks as per standard practice~~
1.06.04	~~Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice~~
1.07.00	PUMPS:
1.07.01	UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.
1.07.02	The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.
1.07.03	The pump rotating parts shall be subjected to static and dynamic balancing.
1.07.04	All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.
1.07.05	Noise and vibration shall be measured during the performance testing at shop.
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	
TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9	
PART-B SUB-SECTION-V-QM1 FGD SYSTEM	
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CLAUSE NO.	QUALITY ASSURANCE	
1.08.00	STRUCTURES , DUCTS, HOPPERS:	
1.08.01	All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.	
1.08.02	Visual inspection of all welds shall be performed in accordance with AWS D1.1.	
1.08.03	NDT requirements of structural steel welds shall be as under: i) ii) iii) 100% RT/UT on butt-welds of plate thickness$\geq$ 32mm. For plates of 25mm$\leq$thickness$<$32mm-10% RT and 100% MPI. For plates of thickness $<$25mm-10% MPI/LPI.	
1.08.04	Edge for shop and field weld shall be examined by MPI for plate thickness $\geq$ 32mm.	
1.09.00	VACUUM BELT FILTER SYSTEM:	
1.09.01	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.	
1.09.02	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.	
1.09.03	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.	
1.09.04	Filter cloths and belts shall be tested for physical properties as per relevant standard	
1.09.05	Hydro cyclones shall be checked by visual, dimensional etc.	
~~1.10.00~~	~~SPRAY NOZZLES:~~	
~~1.10.01~~	~~Spray nozzles shall be tested for physical properties~~	
~~1.10.02~~	~~Spray nozzles also shall be subjected to performance test.~~	
~~1.11.00~~	~~AGITATORS:~~	
~~1.11.01~~	~~Rubber lining shall be tested for hardness and spark test~~	
~~1.11.02~~	~~Impellers shall be tested for dimensional and balancing check~~	
~~1.11.03~~	~~Gear Boxes shall be tested for run test as per standard practice~~	
1.12.00	FANS:	
1.12.01	Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.	
1.12.02	Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.	
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		Page 3 of 4
TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9		
PART-B SUB-SECTION-V-QM1 FGD SYSTEM		

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CLAUSE NO.	QUALITY ASSURANCE			
1.12.03	All rotating components and assemblies of fan shall be balanced dynamically			
1.12.04	Performance test shall be carried out on fans as per Technical specification/ Relevant standard			
1.12.05	Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard			
1.13.00	Thermal Insulation, Lagging & Cladding: (a) Lightly resin bonded mineral wool: LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries. (b) Lagging & Cladding: All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.			
1.14.00	OTHER CRITICAL EQUIPMENTS:			
1.14.01	Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(3)-9		PART-B SUB-SECTION-V-QM1 FGD SYSTEM
Page 4 of 4				

	RAMAGUNDAM-I & II (3 X 200 MW + 3 X 500 MW) GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION PROJECT SPECIFIC GENERAL REQUIREMENTS	SPECIFICATION No: PE-TS-467-571-A101	
		SECTION : I	
		SUB-SECTION : C 2A	
		REV. 00	

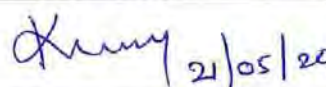
SECTION: I

SUB-SECTION: C 2A

PAINTING SPECIFICATION

		BHEL, Ranipet - 632 406, India. Quality Assurance Department. Painting Scheme			BHEL DOC No: PS:RAMA:FGD:G208 Rev: 00 Dt: 21/05/2020 NTPC Contract No: CS-3120/3130-109(3)-9-FC-NOA-6845 Dt: 22/08/2019 NTPC Doc No: 3130-109-PVM-H-001 Rev: 00 Dt: 21/05/2020			
Project		Ramagundam STPS Stage- I & II FGD Package - BHEL Cust Nos: G208-G210 (3x200 MW) & G509-G511 (3x500 MW)						
SI No	Surface Location	PGMA	Surface Preparation	Primer & Intermediate Coats		Finish Coat		Total DFT (µm min)
				Paint	DFT (µm min)	Paint	DFT (µm min)	

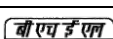
Ramagundam STPS Stage – I & II (3x200 MW + 3x500 MW) FGD PACKAGE
PAINTING SCHEME for FGD SYSTEM, BOOSTER FANS, GATES & DAMPERS

Prepared By	Reviewed & Approved By
 21/05/20	 21/05/2020
K.S. Gopakumar, Dy Engineer / QA	Venkanna Rupani, Dy Manager / QA

Record of Revision

Rev No	Date	Details Of Revision
00	21/05/2020	First Submission

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		BHEL, Ranipet - 632 406, India. Quality Assurance Department. Painting Scheme			BHEL DOC No: PS:RAMA:FGD:G208 Rev: 00 Dt: 21/05/2020 NTPC Contract No: CS-3120/3130-109(3)-9-FC-NOA-6845 Dt: 22/08/2019 NTPC Doc No: 3130-109-PVM-H-001 Rev: 00 Dt: 21/05/2020				
Project		Ramagundam STPS Stage- I & II FGD Package - BHEL Cust Nos: G208-G210 (3x200 MW) & G509-G511 (3x500 MW)							
SI No	Surface Location	PGMA	Surface Preparation	Primer & Intermediate Coats		Finish Coat		Total DFT (μm min)	
				Paint	DFT (μm min)	Paint	DFT(μm min)		

44	Process water pipe accessories, Cooling pipe accessories (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 751 FW 752	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50μ	60 50	Finish: Two coats of Synthetic Enamel to IS 2932, DFT- 50μ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
45	Slurry pipe accessories (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 753	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50μ	60 50	Finish: Two coats of Synthetic Enamel to IS 2932, DFT- 50μ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
46	Service Air pipe accessories (Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30μ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
47	Instrument air pipe accessories (Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30μ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120

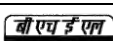
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		BHEL, Ranipet - 632 406, India. Quality Assurance Department. Painting Scheme			BHEL DOC No: PS:RAMA:FGD:G208 Rev: 00 Dt: 21/05/2020 NTPC Contract No: CS-3120/3130-109(3)-9-FC-NOA-6845 Dt: 22/08/2019 NTPC Doc No: 3130-109-PVM-H-001 Rev: 00 Dt: 21/05/2020				
Project		Ramagundam STPS Stage- I & II FGD Package - BHEL Cust Nos: G208-G210 (3x200 MW) & G509-G511 (3x500 MW)							
SI No	Surface Location	PGMA	Surface Preparation	Primer & Intermediate Coats		Finish Coat		Total DFT (μm min)	
				Paint	DFT (μm min)	Paint	DFT(μm min)		

GENERAL NOTES

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

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		BHEL, Ranipet - 632 406, India. Quality Assurance Department. Painting Scheme			BHEL DOC No: PS:RAMA:FGD:G208 Rev: 00 Dt: 21/05/2020 NTPC Contract No: CS-3120/3130-109(3)-9-FC-NOA-6845 Dt: 22/08/2019 NTPC Doc No: 3130-109-PVM-H-001 Rev: 00 Dt: 21/05/2020				
Project		Ramagundam STPS Stage- I & II FGD Package - BHEL Cust Nos: G208-G210 (3x200 MW) & G509-G511 (3x500 MW)							
Sl No	Surface Location	PGMA	Surface Preparation	Primer & Intermediate Coats		Finish Coat		Total DFT (μm min)	
				Paint	DFT (μm min)	Paint	DFT(μm min)		

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

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

	NTPC RAMAGUNDAM - I & II (3x200 MW + 3x500 MW) GYPSUM DEWATERING EQUIPMENT TECHNICAL SPECIFICATION (ELECTRICAL PORTION)	SPECIFICATION No: PE-TS-467-571-A901	
		SECTION : I	
		SUB-SECTION : C-3	
		REV. 00	

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

	ELECTRICAL EQUIPMENT SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 24.03.2022
		SHEET : 1 OF 3
TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT (ELECTRICAL PORTION)		
1 OF 29		

THIS IS PART OF TECHINICAL SPECIFICATION PE-TS-467-571-A901 REV 00

बी एच ई एल 	ELECTRICAL EQUIPMENT SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 24.03.2022
		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 . **GYPSUM DEWATERING EQUIPMENT**

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

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	ELECTRICAL EQUIPMENT SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 24.03.2022
		SHEET : 3 OF 3
compliance certificate/No deviation certificate. 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer. 4.0 List of enclosures : a) Electrical scope between BHEL & vendor b) Specification for Motors c) Specification for cable lugs and glands d) Quality plan for motors e) Electrical Load data format f) BHEL cable listing format		
3 OF 29		

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: GYPSUM DEWATERING EQUIPMENT
SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT
PROJECT: Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	11 kV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	HT motor, (Motor feeder) power supply shall be provided by BHEL For all LT motor & Auxiliary supply, 415 V AC (3 ph. 4 wire)/240 V AC (supply feeder) 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 BHEL 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	BHEL	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 etc.	Vendor	BHEL	
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL BHEL	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	a. Cable glands b. Lugs and bimetallic strip for equipment supplied by Vendor	Vendor Vendor	BHEL BHEL	a. Double compression Ni-Cr plated brass cable glands b. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: GYPSUM DEWATERING EQUIPMENT
SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT
PROJECT: Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)

	equipment supplied by vendor			rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware.	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
13	HT Motor with base plate and foundation hardware.	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
14	HT cable & Cable termination kit for HT Motor	BHEL	BHEL	
15	Mandatory spares	Vendor	-	Vendor to quote as per specification.
16	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
17	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	BHEL	
18	a) Input cable schedules (Control & Screened Control Cables)	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.
	b) Cable interconnection details for above	Vendor	-	
	c) Cable block diagram	Vendor	-	
19	Electrical Equipment & cable tray layout drawings	-	-	Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Gypsum Dewatering Building layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc.
20	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.
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.

SUB-SECTION-II-E2

MOTORS

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

THIS IS PART OF TECHINICAL SPECIFICATION PE-TS-467-571-A901 REV 00

	TECHNICAL REQUIREMENTS
	MOTORS 1.00.00GENERAL REQUIREMENTS 1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment. 1.02.00 All equipment’s shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. 1.03.00 Contactor shall provide fully compatible electrical system, equipment’s, accessories and services. 1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations. 1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment. 1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope. 1.07.00 Degree of Protection Degree of protection for various enclosures as per IEC60034-05 shall be as follows :- i) Indoor motors - IP 54 ii) Outdoor motors - IP 55 iii) Cable box-indoor area - IP 54 iv) Cable box-Outdoor area - IP 55 2.00.00CODES AND STANDARDS 1) Three phase induction motors : IS/IEC:60034 2) Single phase AC motors : IS/ IEC:60034 3) Crane duty motors : IS:3177, IS/IEC:60034 4) DC motors/generators : IS:4722, IS/IEC:60034 5) Energy Efficient motors : IS 12615, IEC:60034-30 Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)

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	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 (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

	TECHNICAL REQUIREMENTS
7.03.00	(a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034) Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV, 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. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
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): <table><tr><td>(a) From 50KW & upto 110KW</td><td>:</td><td>11.0</td></tr><tr><td>(b) From 110 KW & upto 200 KW</td><td>:</td><td>9.0</td></tr><tr><td>(c) Above 200 KW & upto 1000KW</td><td>:</td><td>10.0</td></tr><tr><td>(d) From 1001KW & upto 4000KW</td><td>:</td><td>9.0</td></tr><tr><td>(e) Above 4000KW</td><td>:</td><td>6 to 6.5</td></tr></table>	(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
(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
	parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering 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.
10.01.04	Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.01.05	LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test(subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
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	TECHNICAL REQUIREMENTS
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	LT Motors
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last <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.
10.02.02	However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only 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
	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
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.
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.
Ramagundam (FGD) STPP, Stage-I & II (3x200MW + 3x500 MW)	

	TECHNICAL REQUIREMENTS																												
	TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of bottom terminal stud and gland plate in mm</th></tr><tr><td>UP to 3 KW</td><td>As per manufacturer's practice.</td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>385/203 (For Single core cables only)</td></tr></table> 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: <table><tr><th>Motor MCR in KW</th><th>Clearance</th></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>	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)	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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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

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					ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))		SYSTEM:		PO NO.:		DATE:	
					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
1	2	3	4	5	6		7	8	9	**			
					M	C/ N				M	C	N	
					100%	-				P	-	-	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK				
		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	-
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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	MEASUREMNT & 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	Sign & Date	Name	Name
Prepared by:	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI	Seal
Reviewed by:	PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL	

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

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		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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:		PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL

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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS		STANDARD QUALITY PLAN		SPEC. NO. :	
			CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
			PROJECT:		PO NO.:	
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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY			
1	2	3	4	5	6		7	8	9	**			
					M	C/N				D	M	C	N
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	-	HEAT NO. SHALL BE VERIFIED
		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	Reviewed by:	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

 MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO. :	DATE:17.04.2020
	CUSTOMER :	QP NO.: PE-QP-999-Q-007, REV-04		
	PROJECT:	PO NO.:		
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SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY		
1		3	4	5	6		7	8	9	**		
					M	C/N				D	M	C N
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT	P/V	-	-
					SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC	P/V	-	-
					100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	P	-	-
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK	P/V	-	-
					SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC	P/V	-	-
					100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK	*P/V	-	-
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH TESTS	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS	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

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

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL			
ENGINEERING		QUALITY	
Sign & Date	Name	Sign & Date	Name
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Reviewed by:	PRAVEEN DUTTA	Reviewed by:	R K JAISWAL

BIDDER/ SUPPLIER			
Sign & Date			
Seal			

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			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: II	
			SECTION: 5 OF 9	

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY			
1		2	4	5	6		7	8	9	D	M	C	N
					M	C/N							
2.0	IN PROCESS STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS 2.DIMENSIONS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-
2.2	MACHINING	1.FINISH 2.DIMENSIONS	MA	VISUAL	100%	-	-DO- MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P	-	-
2.3	PAINTING	3.SHAFT SURFACE FLOWS 1.SURFACE PREPARATION	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165 MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✓	P	V	-
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT) 3.SHADE 4.ADHESION	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-
			MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-
			MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-

BHEL			
ENGINEERING		QUALITY	
	Sign & Date	Name	Sign & Date
Prepared by:		HEMA KHUSHWAHA	Checked by:
Reviewed by:		PRAVEEN DUTTA	Reviewed by:

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:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04		
	PROJECT:		PO NO.:		
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM:		
			SECTION: II		
SHEET 7 OF 9					

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

BHEL			
ENGINEERING		QUALITY	
	Sign & Date	Name	Name
Prepared by:		Checked by:	KUNAL GANDHI
Reviewed by:		Reviewed by:	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO. :	DATE:17.04.2020
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SECTION: II	
SHEET 8 OF 9					



SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY				
1	2	3	4	5	6		7	8	9	*				
					M	C/N					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	V ^{\$}	-	\$ 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	V ^{\$}	-	\$ 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 & BTD	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	V ^{\$}	-	\$ 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	V ^{\$}	-	\$ 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	V ^{\$}	-	\$ 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	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✓	P	W\$	-

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

BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL	
Sign & Date		Doc No:	
Seal		Sign & Date	Seal
		Reviewed by:	
		Approved by:	

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS		STANDARD QUALITY PLAN		SPEC. NO :		DATE:17.04.2020
			CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04		
			PROJECT:		PO NO.:		
			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM: SECTION: II		
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SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY	
1	2	3	4	5	6	M	7	8	9	* D	** M C N	
						C/N						
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / STANDARD / (#)	INSPC. REPORT	✓	P	W -
										(#), REFER NOTE-8		

NOTES:

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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

ENGINEERING			BHEL		QUALITY	
Sign & Date	Name	Sign & Date	Name			
Prepared by:	HEMA KHUSHWAHA	Checked by:	KUNAL GANDHI			
Reviewed by:	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:			

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-III																		
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER																		
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=-+24V, L=-24 V																		
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)																		
LOAD DATA (ELECTRICAL)	JOB NO.					ORIGINATING AGENCY			PEM (ELECTRICAL)									
	PROJECT TITLE					NAME			DATA FILLED UP ON									
	SYSTEM					SIGN.			DATA ENTERED ON									
	DEPTT. / SECTION					MAUX			SHEET 1 OF 1			REV. 00			DE'S SIGN. & DATE			

29 OF 29

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	
	LV MOTORS (NON FLAME PROOF)	2	E1027	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK,	Tel.: + 91 (11) 25816931-33, 35 & 36 DT: +91 25724318	
	LV MOTORS (NON FLAME PROOF)	3	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002,	91 11 23460700 - 999 Sunil.Das@cgglobal.com	
	LV MOTORS (NON FLAME PROOF)	4	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY,	044-49681447	
	LV MOTORS (NON FLAME PROOF)	5	K01	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055	Tel: +91-80-23374865 Fax: +91-80-23377706	
	LV MOTORS (NON FLAME PROOF)	6	L04	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA	0217- 2357001-005	APPROVED UPTO 200KW
	LV MOTORS (NON FLAME PROOF)	7	M01	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006	Ph: +91-129-2286421, 2265340, 4006601 to 4006610	
	LV MOTORS (NON FLAME PROOF)	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	
	LV MOTORS (NON FLAME PROOF)	9	E1115	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053	91-22-26730823, 26730789; 91)-(22)-26730154	
	LV MOTORS (NON FLAME PROOF)	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	
ES12	CABLE LUGS	1	E1040	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/	
	CABLE LUGS	2	E1149	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001	033 2282 2540	
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	
	CABLE GLANDS	2	E1017	ARUP ENGG & FOUNDRY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068	033 2473 0850	
	CABLE GLANDS	3	E1206	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018	44-24995505,22680990-4	
	CABLE GLANDS	4	E1036	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063	91-022-26852961/62/63 comet@vsnl.net	
	CABLE GLANDS	5	DW08	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022-29270876/	
	CABLE GLANDS	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	
	CABLE GLANDS	7	I01	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001	91-33-2480161/62/63/64 : 91-33-2485766	Fax



**NTPC RAMAGUNDAM - I & II
(3x200 MW + 3x500 MW)**

GYP SUM DEWATERING EQUIPMENT

**TECHNICAL SPECIFICATION
(C&I PORTION)**

SPECIFICATION No: PE-TS-467-571-A901

SECTION : I

SUB-SECTION : C-4

REV. 00

SECTION: I

SUB-SECTION: C-4

TECHNICAL SPECIFICATION (C&I PORTION)

THIS IS PART OF TECHNICAL SPECIFICATION PE-TS-467-571-A901 REV 00

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

TECHNICAL SPECIFICATION
(CONTROL AND INSTRUMENTATION)
FOR GYPSUM DEWATERING EQUIPMENT

	3X200 + 3X500 MW NTPC RAMAGUNDAM TPP STAGE I & II- FGD		DESG	SK	
	JOB NO: 467		CHKD	SCS	
	REV. NO. 00	DATE:21.05.2020	APPD	SCS	

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

**TECHNICAL SPECIFICATION (C&I) FOR
 GYPSUM DEWATERING EQUIPMENT**

INDEX

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

SECTION: C
SUB SECTION: C&I

**C&I SPECIFIC TECHNICAL REQUIREMENT
FOR DCS BASED
GYPSUM DEWATERING EQUIPMENT**



C&I SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT

SECTION: C
SUB SECTION: C&I

Specific Technical Requirements (C&I):

1. GYPSUM DEWATERING EQUIPMENT (GDE) shall be operated from DCS (BHEL's scope).
2. The Contractor shall provide complete Instrumentation along with necessary fittings, accessories and valve manifold etc for control, monitoring and operation of entire GDS except marked as BHEL's scope in P&ID attached in specification. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.
3. All the Electronic Transmitter for Pressure, Temperature 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.
4. 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.
5. All ON, OFF, and 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.
6. 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.
7. 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.
8. 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 and delivery 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.
9. 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.



C&I SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT

SECTION: C
SUB SECTION: C&I

10. All instruments (except PROFIBUS PA compatible transmitters) and control elements shall be terminated on JB/LCP in field and JB/LCP are in bidder's scope for bidder's supplied instrument and in BHEL's scope for BHEL's supplied instrument. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
11. 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.
12. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
13. 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.
14. Bidder to provide mandatory spares as per mandatory spares list.
15. 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.
16. 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.
17. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
18. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.
19. 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.
20. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.



C&I SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT

SECTION: C
SUB SECTION: C&I

21. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
22. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter, JB/Rack & other erection hardware.
23. Bidder to provide temperature sensor along with temperature transmitter for HT drives i.e. Pump and Motor for BRG and winding temp measurement.
24. Vibration Monitoring System, is envisaged for HT Motor, which is in BHEL scope. However, for mounting of vibration sensors/probe, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors and a notch/slot for mounting of key phasor.
25. Bidder to provide Flow measuring device suitable for the service condition, which shall be decided by BHEL/customer during detail engineering. Bidder to comply the requirement without any commercial implication.
26. Bidder to furnish electrical load/UPS load data during detailed engineering.
27. 415VAC /230 V 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 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.
28. Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.
29. Interface of MCC, HT SWGR, Solenoid valves, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
30. Local control panel and VFD panel, if any required for operation shall be in bidder scope.
31. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.
32. All field instruments enclosure shall be IP65, local panel/cabinet enclosure shall be IP 55, unless otherwise specified.
33. Diaphragm seal shall be provided with Instruments having contact with corrosive media.
34. 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.



C&I SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT

SECTION: C
SUB SECTION: C&I

35. 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 bidder.
36. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm².
37. Use of process actuated shall be avoided unless unavoidable.
38. Number of pairs to be selected for Screen /Control cable
 - a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm²)
 - c) Core Cable: 3CX2.5sqmm²/ 5CX2.5sqmm²/ 12CX1.5sqmm²
39. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
40. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail. The requirements given are to be read in conjunction with detailed Technical specification enclosed.
41. 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.
42. All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack/canopy so that the equipments are protected against rain/ sunlight etc.
43. All instruments should be supplied with valid calibration and test certificates provided by OEM.
44. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.
45. Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.



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46. 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 HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

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.



**C&I SPECIFICATION FOR
GYPSUM DEWATERING EQUIPMENT**

SECTION: C
SUB SECTION: C&I

**GENERAL TECHNICAL REQUIREMENTS
(GYPSUM DEWATERING EQUIPMENT)**

	SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

GENERAL REQUIREMENT

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.

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.

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.

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.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.



**C&I SPECIFICATION FOR
GYPSUM DEWATERING EQUIPMENT**

SECTION: C
SUB SECTION: C&I

LIST OF DOCUMENTS/DELIVERABLES



C&I SPECIFICATION FOR GYPSUM DEWATERING EQUIPMENT

SECTION: C
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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
GYPSUM DEWATERING EQUIPMENT**

SECTION: C
SUB SECTION: C&I

**SPECIFICATION FOR MEASURING INSTRUMENTS
(PRIMARY & SECONDARY), VFD, ELECTRICAL
ACTUATOR AND LCP.**



CLAUSE NO.	TECHNICAL REQUIREMENTS			Page 224 of 55 एनटीपीसी NTPC
1.00.00	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)			
1.01.00	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.			
1.02.00	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.			
1.03.00	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.			
1.04.00	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.			
1.05.00	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). 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. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.			
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.			
1.07.00	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.			
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 1 OF 34	



CLAUSE NO.		TECHNICAL REQUIREMENTS	
		Page 226 of 55 एनटीपीसी NTPC	
		2 Accuracy 3. Stability 4 Turn down 5 Housing 6. Electrical connection 7. Process connection 8. Operating Ambient temperature Overpressure 9 Accessories	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc. 0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2. 50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2 (Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only). Weather proof as per IP-67, metallic housing with durable corrosion resistant coating ½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible ½" NPT (F) 85 deg C without display. 70 deg C with display. 150% of max operating pressure -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.
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		Page 227 of 55 एनटीपीसी NTPC																					
	10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.																					
	11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter																					
16.02.00	Notes																							
	- 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.																							
16.02.00	Temperature Transmitter																							
16.02.01	Single Input /Dual Input Temperature transmitter																							
	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. Following specifications are applicable for dual input/single input temperature transmitter. <table><tr><th>S No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><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></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		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS																					
		PAGE 7 OF 8																						

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	7. Mounting 2 inch pipe mounting with Canopy. 8. Accessories As required by service and operating condition. 9. Composite Accuracy (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 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.		
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

CLAUSE NO.

TECHNICAL REQUIREMENTS

2.02.00

GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
	4.	Power supply	24 V DC +/- 10%.
	5.	Temperature compensation	To be provided within transducer.
	6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
	7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator/ centralized PC based system (as applicable).
	8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
	9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
	10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
	11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
	12.	Display	Integral digital display
	13.	Diagnostics	Loss of echo alarm etc.
	14.	Load Impedance	500 ohms (minimum).
	15.	Electrical Connection	Plug and socket
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 5 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	4.	Power supply	24 V DC +/-10%.
	5.	Temperature compensation	To be provided within transducer.
	6.	Housing	Weather proof as per IP-55 with durable corrosion resistance coating.
	7.	Adjustment/calibration/maintenance	From hand held calibrators/centralized PC based system (as applicable).
	8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual to calibrate the instrument without any process flow.
	9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
	10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
	11.	Range	Should be suitable for the required process range.
	12.	Display	LCD display with integral keypad to be provided.
	13.	Diagnostics	Loss of echo alarm etc.
	14.	Load Impedance	500 ohms minimum
	15.	Electrical Connection	Plug and socket
	16.	Accessories	• All weather canopy for protection from direct sunlight and direct rain. • All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316. • For hazardous area, explosion proof enclosure as described in NEC article 500
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
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.02.00	Resistance Temperature Detector (RTD)	
	Sr. No.	Features

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.04.00	Thermocouple wire gauge 16 AWG Protective sheath SS 321 Protective sheath dia 8 mm OD Calibration & accuracy As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C 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. 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. Minimum bending radius 30 mm Length of T/C On as required basis considering location of measurement point and the JB/TTJB location. Notes : 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. Thermo well (for all process temp. elements) (a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974) (b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided. (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). (d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2
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CLAUSE NO.	Page 236 of 550  TECHNICAL REQUIREMENTS																																											
4.00.00	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE. <table border="1"> <tr> <th>Sl. No</th><th>FEATURES</th><th colspan="3">ESSENTIAL/MINIMUM REQUIREMENTS</th></tr> <tr> <td></td><td></td><td>Pr. Gauge/ DP Gauge/ Draught gauges</td><td>Temperature Gauge</td><td>Level Gauge</td></tr> <tr> <td>1</td><td>Sensing Element</td><td>Bourdon for high pressure, Diaphragm/ Bellow for low pr.</td><td>Inert gas actuated/ Liquid filled other than mercury</td><td>Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.</td></tr> <tr> <td>2</td><td>Material of sensing element</td><td>SS 316</td><td>SS 316</td><td></td></tr> <tr> <td>3</td><td>Material of movement</td><td>SS 304</td><td>SS 304</td><td></td></tr> <tr> <td>4</td><td>Body material</td><td>Die-cast aluminium</td><td>Die-cast aluminium</td><td>Forged carbon steel/304 SS</td></tr> <tr> <td>5</td><td>Dial size</td><td>150mm</td><td>150 mm</td><td>Tubular covering entire range</td></tr> <tr> <td>6</td><td>End connection</td><td>1/2 inch NPT (M)</td><td>1/2 inch or 3/4 inch NPT (M).</td><td>Process connection as per ASME PTC and drain/vent 15 NB</td></tr> </table>				Sl. 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
Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS																																										
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge																																								
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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																																								
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 12 OF 34																																								



CLAUSE NO.	TECHNICAL REQUIREMENTS				
	7	Accuracy	$\pm 1\%$ of span	$\pm 1\%$ of span	$\pm 2\%$
	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.				
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 13 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.00.00	PROCESS ACTUATED SWITCHES			
	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
		Pressure/ Draft Switches/ DP Switches	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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6.00.00	Power Supply (wherever required)	As per Contractor's Standard practice.
	Notes :- 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.	
6.00.00	SOLENOID VALVES Solenoid valves shall fulfill the following requirements: - 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	Limit switches 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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9.00.00	SPECIFICATION FOR FLOW ELEMENTS		
9.01.00	Orifice Plate		
	Features	Essential/Minimum Requirements	
	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167	
	Material	316 SS	
	Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.	
	Material of branch pipe	Same as main pipe	
	Root valve type	Globe	
	Root valve material	Same as pipe material	
	Root valve size	1 / 2 inch or 1 inch (as applicable)	
	Impulse pipe of same material up to root valve	Required	
	Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.	
	Beta Ratio	0.34 to 0.7	
	Beta Ratio calculation to be submitted	Yes	
	Assembly drg. and flow Vs DP Curves	Yes	
	Accessories	Root valves, flanges, Vent/drain hole (As required)	
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	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.

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 17 OF 34

CLAUSE NO.		TECHNICAL REQUIREMENTS		Page 242 of 550 एनटीपीसी NTPC																									
9.04.00																													
		ROTAMETERS																											
		<table><tr><td>Sr. No.</td><td>Features</td><td colspan="2">Essential / minimum requirements</td></tr><tr><td>1.</td><td>Type</td><td>Variable Area Metal Tube</td><td></td></tr><tr><td>2.</td><td>Fluid media</td><td>Water/oil</td><td></td></tr><tr><td>3.</td><td>Tube body</td><td>SS316</td><td></td></tr><tr><td>4.</td><td>Material of float</td><td>316 SS</td><td></td></tr><tr><td>5.</td><td>Indicator</td><td>Linear scale</td><td></td></tr></table>				Sr. No.	Features	Essential / minimum requirements		1.	Type	Variable Area Metal Tube		2.	Fluid media	Water/oil		3.	Tube body	SS316		4.	Material of float	316 SS		5.	Indicator	Linear scale	
Sr. No.	Features	Essential / minimum requirements																											
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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																									
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CLAUSE NO.	Page 243 of 550 NTPC TECHNICAL REQUIREMENTS			
10.00.00	6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)	
	7.	Housing protection class	IP-55	
	8.	Accuracy	$\pm$ 2% of measured value.	
	ANALYSER INSTRUMENTS (OTHER THAN CEMS):			
	Common Requirements			
	1	Output signals		
		Analog	4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station.	
		Binary	2 NO + 2 NC for high alarm	
	2	Zero & span Adjustment	To be provided with range selection facility.	
	3	Ambient temp.	50°C	
	4	Indication	Digital Alphanumeric Display. Display of reading in engineering units shall be provided.	
	5	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS.	
	6	Type of Electronics	Microprocessor based with self diagnostic.	
	7	Digital Signal transmission	HART / RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with plant control system.	
	8	Calibration	Auto & Manual (from Remote)	
	9	Power Supply	To be arranged by Contractor subject to Employer's approval.	
	10.	Others	All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to local junction box are to be provided.	
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 19 OF 34



CLAUSE NO.	TECHNICAL REQUIREMENTS			
			All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.	
	11.	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards	
	12.	Type of Technology	SO ₂ :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type For Hot-extractive sampling type and Dilution extractive type systems, the entire system including analysers, sample handling/conditioning system etc offered shall be sourced from/assembled at Original Analyser manufacturer(OAM) works	
	13	Measurement Range, Tapping point	As per FGD system design and process parameter	
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 20 OF 34

12.00.00

SPECIFICATION OF ANALYSERS

12.01.00

Common Requirements

1.	Type of electronics	Microprocessor based
2.	Zero & span Adjustment	To be provided
3.	Ambient temp.	50°C
4.	Display	LCD
5.	Enclosure Type / Material	Weather and Dust proof (IP 55), Die cast aluminum with corrosion resistant epoxy coating for external field mounting analysers
6.	Output signals Analog	4-20 mA DC
7.	Error / fault Diagnostic	To be provided.
8.	Power supply	The power supply to all the analyzers / monitors shall be supplied by contractor

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CLAUSE NO.	TECHNICAL REQUIREMENTS	
		with all necessary switches, fuses, wiring / cabling and other required accessories etc. for distribution to individual requirements.
	9. Load	500 Ohms minimum
	10. Mounting	All mounting arrangements for the sensors and the monitors are to be provided by the Contractor. SWAS instruments to be mounted in the panel except Hotwell analysers. For the same and other field application free standing cabinet(s) / panel / rack is to be provided by the Contractor for mounting the analysers / transmitters / meters as applicable due to environment.
	11. Other Requirements	All chemical reagents required for silica, phosphate, sodium, chloride, residual chlorine and hydrazine analyzers for 12 months operation is to be supplied in phased manner depending on shelf life.

12.03.00	pH analyser		
	1. Type	Continuous flow through type	
	2. Range	0 - 14 pH freely programmable	
	3. Accuracy	< ± 1% of reading	
	4. Temperature Compensation	Automatic	
	5. No. of Streams	Single	
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 31 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		Page 247 of 55 एनटीपीसी NTPC
14.00.00	Electronic Flow-Meter Electronic Flow-meters shall be provided where ever indicated in the P&IDs. The electronic flow meter shall include flow sensor and flow indicator cum integrator/totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore ultrasonic/electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner. The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feedback on satisfactory performance of the instruments. The flow meter shall meet or exceed the following requirement: (a) Output : 4-20 mA DC Isolated output (b) Accuracy : ± 0.5% of calibrated span or better * (c) Repeatability : ± 0.2% of calibrated span or better (d) Ambient Temp. & : Humidity 4 deg.C to 55 deg.C. 5% to 100% RH (e) Power Supply : 240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor. (f) Protection class : IP-55 (g) Flow tube SS304 (h) liner Hard Rubber The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.		
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 34 OF 34



CLAUSE NO.		TECHNICAL REQUIREMENTS	
1.00.00		GENERAL:	
1.01.00		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.	
1.02.00		This sub-section of specification is applicable for following types of electric actuators:	
1.02.01		Modulating duty electric actuators:	
		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.	
1.02.02		Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):	
		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.	
2.00.00		COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS	
2.01.00		TYPE:	
2.01.01		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.	
2.01.02		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.	
2.02.00		RATING:	
		(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%.	
		(b) Sizing:	
		Open/Close at rated speed against designed differential pressure at 90% of rated voltage.	
		For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.	
		For inching type: 150 starts per hour or required cycles, whichever is higher.	
2.03.00		CONSTRUCTION:	
		(a) Enclosure:	
		Totally enclosed weatherproof, minimum IP-68 degree of protection.	
		(b) Manual Wheel:	
		Shall disengage automatically during motor operation.	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIIC-8 ELECTRIC ACTUATORS
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.04.00	MOTOR: (a) Type : Squirrel cage induction motor suitable for Direct On Line (DOL)starting. (b) Enclosure: Totally enclosed, self-ventilated. (c) Insulation Class F. Temperature rise 70 Deg C. over 50 Deg C ambient. (d) Bearings: Double shielded, grease lubricated antifriction. (e) Earth Terminals: Two (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.		
2.05.00	POSITION/TORQUE TRANSMITTER: 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.		
2.06.00	LOCAL OPERATION: It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.		
2.07.00	LCD DISPLAY: A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.		
2.08.00	WIRING: Suitable voltage grade copper wire.		
2.09.00	TERMINAL BLOCK: For power cables, the grade of TBs shall be minimum 650V.		
2.10.00	ACCESSORIES: 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.		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C-8 ELECTRIC ACTUATORS	PAGE 2 OF 4

CLAUSE NO.	Page 250 of 550 एनटीपीसी NTPC TECHNICAL REQUIREMENTS		
2.11.00	SIL CERTIFICATION: All actuators shall be certified for SIL 2 or better.		
3.00.00	SPECIFIC REQUIREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS		
3.01.00	INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only. (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. (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. (c) Open/close command termination logic shall be suitably built inside actuator. (d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable)		
3.02.00	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.		
3.03.00	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.		
4.00.00	SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS		
4.01.00	INTERFACES: For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network. (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. (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. (c) Open/close command termination logic shall be suitably built inside actuator.		
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.	Page 251 of 550 एनटीपीसी NTPC TECHNICAL REQUIREMENTS
4.02.00	TERMINAL BOX: 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.
4.03.00	TRAINING: Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

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.	TECHNICAL REQUIREMENTS
	CONTROL VALVES, ACTUATORS & ACCESSORIES 1.00.00 CONTROL VALVES & ACCESSORIES 1.01.00 General Requirements 1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification. 1.01.02 All the control valves and accessories offered by the Bidder, shall be from reputed, experienced manufacturers of specified type and range of valves. 1.02.00 CONTROL VALVE SIZING & CONSTRUCTION 1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes. 1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering. 1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished. 1.02.04 Control valves shall have leakage rate as per leakage Class-IV.
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2 SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES PAGE 1 OF 5



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CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.		
2.00.00	VALVE CONSTRUCTION		
2.01.00	All valves shall be of globe /Butterfly body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.		
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.		
2.03.00	Cast Iron valves are not acceptable.		
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.		
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.		
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)		
2.07.00	Valve characteristic shall match with the process characteristics.		
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.		
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.		
3.00.00	VALVE MATERIALS		
	Refer mechanical sections for body and trim materials. The exact body and trim materials shall be finalised during detailed engineering depending on the service applications.		
	However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 2 OF 5



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CLAUSE NO.	TECHNICAL REQUIREMENTS																
4.00.00	END PREPARATION Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalised during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.																
5.00.00	VALVE ACTUATORS All Control Valves shall be furnished with Pneumatic Actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified. The travel time of the pneumatic actuators shall not exceed 10 seconds.																
6.00.00	CONTROL VALVE ACCESSORY DEVICES																
6.01.00	All pneumatically actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.																
7.00.00	SPECIFICATIONS FOR MICROPROCESSOR BASED POSITIONERS <table> <tr> <td>1</td> <td rowspan="4">Electrical</td> <td>a) Input signal</td> <td>4-20 mA</td> </tr> <tr> <td></td> <td>b) Power Supply</td> <td>Loop powered from the output card of control system.</td> </tr> <tr> <td></td> <td>c) Hart Protocol</td> <td>Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA))</td> </tr> <tr> <td></td> <td>d) Valve position sensing</td> <td>Non contact type position sensing with 4-20 mA output signal</td> </tr> </table>				1	Electrical	a) Input signal	4-20 mA		b) Power Supply	Loop powered from the output card of control system.		c) Hart Protocol	Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA))		d) Valve position sensing	Non contact type position sensing with 4-20 mA output signal
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 3 OF 5													



CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2	Environment	a) Operating Temp	(-)30 To 80 Deg. C
			b) Humidity	0-95 %
			c) Protection Class	IP-65 Minimum
	4	Test reports/certificates	Factory Valve Signature Tests reports (Pr vs Valve travel and Travel vs I/P signal) are to be provided.	
			Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted	
	5	Configuration/calibration	Remote calibration, Auto & Manual calibration shall be possible. Universal HART Calibrator to be provided.	
	6	Operating	Operating Range	Full range & split range signal.
	7	Modes	Valve Action	Direct & Reverse valve action(selectable)
			Flow Characterization	Possible to fit valve characteristic curve - Linear & Equal Percentage.
	8	Fail Safe/Fail Freeze	Fail safe/Fail freeze feature is to be provided. (In case, the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
	9	Pneumatic	Air capacity	Sufficient to handle the valves selected/boosters to be supplied if required.
			Air supply pressure	To suit air supply pressure/quality available.
			Process connection	1/4 inch NPT
	10	Electrical Cable Entry	1/2-NPT, side or bottom entry to avoid water ingress.	
	11	Performance	Characteristic Deviation	<=0.5 % Of Span
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2		SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
			Ambient Temp Effect	<=0.01 %/Deg C Or Better
	12	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent
	13	Accessories	In-built operator panel	Display with push buttons for configuration and display on the Positioner itself (password protected/hardware lock).
			Press gauge block	For supply & output pressure.
			Mounting assembly	On as required basis.
8.00.00	TEST AND EXAMINATION All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following: 8.01.00 Non Destructive Test as per ANSI B-16.34. 8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test. 8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above. 8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position. 8.05.00 CV Test: Refer Cl.no 3.00.00 (8) Subsection IIIC-06 (Type test requirements) 9.00.00 CONTROL VALVE QUANTITIES Bidder shall furnish all the control valves under this package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.			
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 5 OF 5

VFD

Variable Frequency Drive (VFD)

1.00.00

GENERAL

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the former shall prevail. All work shall be carried out as per the following codes and standards.

2.00.00

CODES AND STANDARDS

HT breaker	IEC:60056
DC reactor	IEC 60289
Transformers	IS:2026, IEC: 60076 IEC 61378
Bushing	IS: 2099, IEC 60137
Adjustable Speed Electrical Power Drive Systems	IEC 61800
Semiconductor converters–General requirements	IEC 60146
IEEE Recommended practices and requirements for harmonic control in electrical power systems	IEEE 519
Degrees of protection provided by enclosures (IP Code)	IEC 60529
Electrostatic immunity test	IEC1000-4-2
Fast transient immunity test	IEC1000-4-4
Surge immunity test	IEC1000-4-5
High-voltage switchgear and controlgear; Pt.102: Alternating current disconnectors and earthing switches	IEC 62271-102
High-voltage switchgear and controlgear; Pt.200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 KV	IS/IEC: 62271-200
AC electricity meters	IS: 722
Metal oxide surge arrestor without gap for AC system	IEC: 60099-4
Terminal blocks for copper conductors	IEC: 60947-7-1
Dry transformer	IS: 11171
Motor	IEC 60034-18-41 &42, IEC60034 / NEMA 30 & 31,
Contactor/Switches/Fuses etc.	IEC:60947, IS: 13947
Harmonics & EM compatibility	IEEE:519/IEC: 61000
VFD	IEC:60034/ IEC: 61800

Equipment complying with other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate

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	the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force as on date of opening of bid and shall clearly bring out the salient features for comparison. 3.00.00 OPERATING CONDITIONS 3.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and also relative humidity of 95% at 40 deg. Celsius shall be considered. 3.02.00 All equipment 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. 3.03.00 The auxiliary AC voltage supply arrangement shall have 11/6.6/3.3kV and 415V systems (as applicable). It shall be designed to limit voltage variations as given below under worst operating condition: 1. 11kV/ 3.3 kV/ 6.6 KV : +/- 6% 2. 415V : +/- 10% Note: The Voltage level mentioned above is the Nominal Voltage available at the input of the VFD System from the MCC/ Switchgear/transformer, based on the system requirement/Availability. The voltage level for the VFD output to be fed to motor shall be as follows:- 1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC 2. Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC 3. Above 700KW : Medium Voltage From here onwards in the specifications all the VFD Systems consisting of either 415 V or 690 V may be termed as LV VFD while the higher rated VFD System shall be termed as MV VFD. If nothing is mentioned than the Clause is applicable for both the LV and the MV VFD until deliberated otherwise. 4.00.00 SYSTEM DESCRIPTION <table> <tr> <td>Type of drive</td><td>3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT</td></tr> </table> 5.00.00 <table> <tr> <td>Type of Cooling of VFD</td><td>Naturally air cooled/forced air cooled/Liquid cooled</td></tr> <tr> <td>Converter Type</td><td>Full wave diode rectifier/active front end type</td></tr> <tr> <td>Inverter Type</td><td>Thyristor/IGBT/IGCT/SGCT/IEGT</td></tr> </table> GENERAL REQUIREMENTS 5.01.00 Medium Voltage VFD: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system	Type of drive	3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT	Type of Cooling of VFD	Naturally air cooled/forced air cooled/Liquid cooled	Converter Type	Full wave diode rectifier/active front end type	Inverter Type	Thyristor/IGBT/IGCT/SGCT/IEGT
Type of drive	3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT								
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Converter Type	Full wave diode rectifier/active front end type								
Inverter Type	Thyristor/IGBT/IGCT/SGCT/IEGT								

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5.02.00	shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design. 415 V/690 V LV VFD: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements.
5.03.00	The system shall be fully digital, PLC/Microprocessor based, energy efficient, and shall provide very high reliability, high power factor, low harmonic distortion and low vibration and wear and noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.
5.04.00	The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered.
5.05.00	The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the supply system. All the Motors which are to be driven by VFDs will be of Inverter duty type. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & supply system.
6.00.00	TECHNICAL AND OPERATIONAL REQUIREMENTS
6.01.00	The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with worst input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment.
6.02.00	The overload capacity of the controller shall be 150% of the rated current of the motor for one minute for constant torque applications and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload.
6.03.00	The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified by the load: a. Variable torque changing as a function of speed. b. Constant torque over a specific speed range. c. Constant power over a specific speed range. d. Any other as specified in data-sheet
6.04.00	VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed.

- 6.05.00 The above compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.
- 6.06.00 VFD shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. Any damage resulting from such a short circuit or internal fault shall be limited to the component concerned.
- 6.07.00 The system shall be suitable to maintain speed variation within range 10-110% or as per the requirement of driven equipment with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.
- 6.08.00 The VFD System shall maintain a power factor of 0.95 (minimum) (for LV VFD system) and 0.9 (minimum) (for MV VFD system) in the entire operating range.
- 6.09.00 Maximum allowable audible noise from the VFD system will be 85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions.
- 6.10.00 All the circuit components shall be suitably protected against over voltages, surges, lightning etc.
- 6.11.00 The panels shall be designed to provide easy access to hardware, to facilitate replacement of cards in case of any failure.
- 6.12.00 All the VFDs for particular application shall be of same design so as to ensure 100 % interchangeability of components.
- 6.13.00 For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. At least 30 time tagged fault messages shall be stored in the drive's fault history.
- 6.14.00 The VFD cubicles shall be placed in air conditioned environment. However if VFDs of less than 100 kW are designed to operate in non-air condition environment the same shall also be acceptable.
- 6.15.00 The 3-Phase Thyristor/IGCT/SGCT/ multistage IGBT/IEGT based VFD system shall have minimum number of components to ensure very high reliability. The input side converter shall have 3-Phase Diode/Thyristor bridge configuration modular type and inverter shall be of 3-Phase Thyristor/IGCT/SGCT/multi stage IGBT/IEGT type, using Pulse Width Modulation or better technique for generating near sine wave output to motor.
- 6.16.00 Fiber optic cable connection shall be provided preferably to ensure high network reliability.
- 7.00.00 **VFD COMPATIBILITY WITH THE MOTOR**
- 7.01.00 MV VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads, with a total harmonic current and voltage distortion within acceptable/standard limits. VFD with transformers on output side are not acceptable.

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7.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.
7.03.00	VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.
8.00.00	BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)
8.01.00	The VFD System shall have an optional feature to run the motor under bypass arrangement for operation of Motor with VFD bypassed. During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode.
8.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.
9.00.00	STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)
9.01.00	A Common standby arrangement with auto/manual switchover shall be provided in case of failure of any VFD in a group of drives. Complete protection, interlocks & control required shall be provided in the changeover module.
10.00.00	EFFICIENCY
10.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for LV VFD and minimum 94 % for MV VFD at rated load and speed. Overall Efficiency evaluation shall include input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls, such as internal VFD control boards, cooling fans/pumps.
10.02.00	In absence of valid test report, a factory test shall be performed at the VFD manufacturer's facility verifying the efficiencies. Manufactures who are supplying Drive and transformer from different locations, efficiency test will be conducted separately for Drive and transformer.
11.00.00	COOLING SYSTEM
11.01.00	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95 %(at 40 deg C).
11.02.00	VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system (Closed Loop System).
11.03.00	In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD

CLAUSE NO.	.. VARIABLE FREQUENCY DRIVES Page 263 of 550		
	Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.		
11.04.00	Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.		
12.00.00	TRANSFORMER:		
12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.		
12.02.00	All other components, technical parameters shall be as per applicable IEC/IS.		
12.03.00	Enclosure for Dry Type Transformer (as applicable) Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting.		
12.04.00	<table> <tr> <td>Core</td><td>Shall be High grade non-ageing cold rolled grain oriented silicon steel Laminations.</td></tr> </table>	Core	Shall be High grade non-ageing cold rolled grain oriented silicon steel Laminations.
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12.05.00	<table> <tr> <td>Winding conductor</td><td>Shall be electrolytic grade copper. Windings shall be of class F insulation.</td></tr> </table>	Winding conductor	Shall be electrolytic grade copper. Windings shall be of class F insulation.
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12.08.00	<table> <tr> <td>Temperature rise:</td><td>Winding temperature rise shall be as per applicable IEC.</td></tr> </table>	Temperature rise:	Winding temperature rise shall be as per applicable IEC.
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13.00.00	POWER CONVERTER:		
13.01.00	The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.		
13.02.00	The converter shall be coordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.		
13.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.		
13.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.		
13.05.00	The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD		

	through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values.
13.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.
13.07.00	The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.
13.08.00	The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
14.00.00	OUTPUT FILTER (AS APPLICABLE):
14.01.00	Output/ dv/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress.
15.00.00	DC LINK CAPACITOR (AS APPLICABLE):
15.01.00	Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.
16.00.00	AC/DC Reactor (As applicable)
	1) Type: Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously. 2) Insulation: Thermal Class 155(F), temperature rise is limited to thermal class 130 (B). 3) Noise level shall not exceed value specified in NEMA TR-1.
17.00.00	VFD PANEL REQUIREMENTS
17.01.00	Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. In case dry type transformer is provided inside VFD panels, the enclosure and in its frame thickness shall be same as indicated in this para.
17.02.00	The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.
17.03.00	All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 3X or better for MV VFD and IP: 4X or better for LV VFD as per IS/IEC 60947

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17.04.00	Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.
17.05.00	Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.
17.06.00	Proper ventilation using air filters and fans/pumps shall be provided in the panels to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.
18.00.00	PAINTING Paint shade shall be as follows a) VFD transformer : RAL 5012 (Blue), legend in black letter reactor enclosure b) Motors : RAL 5012 (Blue) c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)
19.00.00	HT SWITCHGEAR
19.01.00	The technical requirements of HT switchgear shall be as per chapter of HT switchgear in Part-B of Technical specifications.
20.00.00	MOTORS
20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side.
20.02.00	Motors shall also meet the requirements mentioned in subsection for motors and relevant IS/IEC.
20.03.00	Motor shall be suitable for operation with a solid state power supply consisting of an adjustable frequency inverter for speed control & shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
20.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800.
20.05.00	Drive manufacturer shall coordinate with the motor manufacturer for proper selection of the motor for the given load application and the output characteristics of the drive.
20.06.00	Other requirements of motor shall be as stipulated in technical chapter of Motors in Part-B of technical specifications.
21.00.00	LT & HT CABLES
21.01.00	Contractor's scope shall also include LT and HT cables suitable for VFD system and Motors.
22.00.00	CONTROL AND PERFORMANCE REQUIREMENTS

- 22.01.00 The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a "soft start" torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor.
- 22.02.00 It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified.
- 22.03.00 Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS.
- Man machine interface for (MV) VFD shall have one flat TFT monitor with keyboard (password protected) in the VFD room and a color laser printer for system alarm and monitoring located in control room.
- Parameter Monitoring:
- Input and output voltage of Drive
 - Input and output current of Drive
 - Motor speed
 - Input and output power frequency of Drive
 - Torque
 - Input and Output power of Drive system (covering transformer if applicable)
 - Output kWhr of Drive
 - Transformer (if applicable) temperature for alarm & trip.
 - Ambient temperature
 - Run/stop and local/remote status displayed
- 22.04.00 Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc.
- 22.05.00 Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation.
- 22.06.00 User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
- 23.00.00 **PROTECTION FEATURES**
- 23.01.00 The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following:
- i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection.
 - ii) Incoming and outgoing line surge protection.
 - iii) Under / over voltage protection
 - iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection.

- v) Instantaneous Over current & Earth fault protection
- vi) Converter/Inverter module failure indication.
- vii) Over frequency/speed protection.
- viii) Ventilation failure indication & alarm.
- ix) Over temperature of VFD
- x) Bearing temperature protection.
- xi) System earth fault protection.
- xii) Speed reference loss protection.

23.02.00 Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.

24.00.00 **CONTROL FEATURES**

24.01.00 Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door.

- i) Start / stop (in local/remote mode)
- ii) Speed control (Raise / lower)
- iii) Acknowledge/Accept/ Test Push Button for annunciation
- iv) Auto / Manual / Test Mode select
- v) Emergency stop
- vi) Trip-Remote Breaker

25.00.00 **DIAGNOSTIC FEATURES**

25.01.00 The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

25.02.00 Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.

26.00.00 **SERVICEABILITY / MAINTAINABILITY**

26.01.00 Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.

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26.02.00	Marking / Labeling: Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system.
27.00.00	STORAGE AND PRESERVATION
27.01.00	The Contractor shall be responsible for the storage and preservation of all the equipments to be supplied under the VFD System, till the time of successful installation and commissioning. The equipment should be suitable for storage for long periods before installation. Contractor should take adequate measures to ensure that no damage happens to the VFD System due to storage and preservation.
28.00.00	TESTS
28.01.00	ROUTINE TESTS All acceptance and routine tests as envisaged in QA section shall be carried out. Charges for these shall be deemed to be included in the equipment price.
28.02.00	TYPE TESTS
28.02.01	The Contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule 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.
28.02.02	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 Contractor. The Contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
28.02.03	In case the Contractor 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 Contractor.
28.02.04	Further the Contractor 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 Contractor 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 Contractor 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.

CLAUSE NO.	“ VARIABLE FREQUENCY DRIVES ” Page 269 of 550
28.03.00 28.04.00	LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted under this contract for MV VFD i) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load ii) Temperature rise test iii) Noise level iv) Harmonics of No load current.(Input/Output) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for VFD Panels’ 1) VFD panels (For LV VFD) i. Rated Current/ Output ii. Temperature rise test iii. Noise level test iv. Power Loss Determination Test v. Power factor measurement. vi. Degree of Protection Test vii. EMC Test viii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800 2) VFD panels (For MV VFD) i. Rated Current/ Output ii. Current Sharing iii. Voltage Division iv. Power Loss Determination Test v. Power factor measurement. vi. Degree of Protection Test vii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800 3) AC/DC Reactor i. Lightning impulse test(If applicable) ii. Heat run test iii. Short time current test(If applicable) iv. Noise level test 4) Transformers (In case of non integrated type)

CLAUSE NO.	“ VARIABLE FREQUENCY DRIVES Page 270 of 550
	i. As per requirements mentioned in subsection for Transformer chapter in technical specifications.

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.00.00	CONTROL DESK & PANELS			
1.01.00	GENERAL			
1.01.01	All control desk, panels, LVS panel etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.			
1.01.02	All panels, desks, cabinets shall be free standing type & have bottom / top entry for cables to be finalised application wise during detailed engineering stage. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire. Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.			
1.01.03	Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. The exact color shall be finalised during detailed engineering.			
1.01.04	The design shall conform to the EN ISO 11064 (Ergonomical design of control room), Part-1,2 and 3.			
2.00.00	CONTROL DESK & PANEL			
2.01.00	GENERAL			
2.01.01	The exact dimensions, material, construction details, grounding, general arrangement etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering and subjected to Employer's Approval.			
2.01.02	For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.			
2.02.00	Control Desk (CD)			
2.02.01	Control desk shall be Modular, non-welded construction free standing table top type with front & back cover constructed of 1.6 mm thick CRCA steel plates. The tabletop of the control desk shall be arc-shaped for mounting TFT monitors & mice. The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface (ASS) and the remaining 18mm of laminated medium density fiber board. Work surface shall be made of two different colors at same level and seamlessly joined in each section. The structure frame shall consist of extruded aluminum top and bottom horizontal beams and vertical support tensioned together to form an integrated, finished curvilinear shaped frame. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for the structure frame. Extreme side legs shall be illuminated type and should complete the			
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIC-9 CONTROL DESK & PANELS	PAGE 1 OF 3

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	overall form and aesthetics of the desk. It shall have concealed cable & wire way management system. Telephone sets shall be mounted on the control desk. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.			
2.02.02	All operator monitors & mice shall be mounted on this CD.			
2.02.03	The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.			
2.03.00	Internal Panel/Desk Items Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.			
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B BID DOC. NO.: CS-0011-109(1A)-2	SUB-SECTION-IIIC-9 CONTROL DESK & PANELS	PAGE 2 OF 3



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.



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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test



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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- | | | |
|-----------------------------------|---|-------------------------------|
| - Data sheet A&B for Local Panels | : | Data sheet no. PES-145A-DS1-0 |
| - Data sheet C for Local Panels | : | Data sheet no. PES-145A-DS2-0 |

A technical drawing of a bent pipe. The drawing shows a pipe with a 90-degree bend. Dimensions are labeled as follows: A is the radius of the bend; B is the distance from the center of the bend to the center of the first flange; C is the distance from the center of the first flange to the center of the second flange; D is the distance from the center of the second flange to the center of the third flange; E is the distance from the center of the third flange to the center of the fourth flange; G is the distance from the center of the fourth flange to the center of the fifth flange; H is the distance from the center of the fifth flange to the center of the sixth flange; and J is the total length of the pipe.

S.No.	Conductor Size HT Power Cables	E (Dimensions in mm)
1	95 sq.mm	13
2	150 sq.mm	17
3	300 sq.mm	17

[illegible]



**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

SECTION: C
SUB SECTION: C&I

**INSTRUMENTATION CABLE,
CABLE INTERCONNECTION AND
TERMINATION PHILOSOPHY**

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CLAUSE NO.	TECHNICAL REQUIREMENTS													
1.00.00	INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)													
1.01.00	General requirements													
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.													
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.													
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.													
1.01.04	cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.													
1.01.05	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.													
1.01.06	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.													
2.00.00	SPECIFICATION OF INSTRUMENTATION CABLE													
2.01.00	Common Requirements													
	<table><tr><th>S. No.</th><th>Property</th><th>Requirement</th></tr><tr><td>1</td><td>Operating Voltage</td><td>225 V (peak value)</td></tr><tr><td>2.</td><td>Codes and standard</td><td>All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.</td></tr><tr><td>3.</td><td>Continuous operation suitability</td><td>At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.</td></tr></table>	S. No.	Property	Requirement	1	Operating Voltage	225 V (peak value)	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.	3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.	
S. No.	Property	Requirement												
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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2	SUB-SECTION-III-C4 INSTRUMENTATION CABLES	PAGE 1 OF 13											

CLAUSe NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
2.02.00	S. No.	Property	Requirement		
	4.	Marking :- a.Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath. b.Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.			
	5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet		
	6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.		
	7.	Ovality at any cross-section	Not more than 1.0 mm		
	8.	CAGE-CLAMP suitability	To be provided		
	9.	Color	The outer sheath shall be of blue color.		
	10.	Others	Repaired cables shall not be acceptable.		
	Specific Requirements				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. CONDUCTORS					
Cross section area	0.5 sq. mm				
Conductor material	ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX	
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red	
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1	
No & dia of strands	7x0.3 mm (nom)				
No. of Pairs	2	2	2/4/8/12/16/24 / 48	2	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2		SUB-SECTION-III-C4 INSTRUMENTATION CABLES	PAGE 2 OF 13	

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	
	Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1	
	Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1	
	B. INSULATION					
	Material	Extruded PVC type YI 3			Teflon (i.e. extruded FEP)	
	Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)	
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.			2.8x 10 ¹⁴ at 20 deg. C & 2x10 ¹¹ at 205 deg. C.	
	C. PAIRING & TWISTING					
	Max. lay of pairs (mm)	50				
	Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair	Yes		Each core printed with number or Numbered binder tape to be provided on each pair	
	Bunch (Unit Formation) for more than 4P	N.A	To be provided		N.A	
	Conductor /pair identification as per VDE0815	N.A.	To be provided		N.A.	
	D. SHIELDING					
	Type of shielding	Al-Mylar tape				
	Individual pair shielding	No	To be provided for F-type cable		No	
	Minimum thickness of Individual pair shielding	No	0.028mm (28 micron)		No	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	
	Overall cable assembly shielding	To be provided				
	Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)				
	Coverage / Overlapping	100% / 20%				
	Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper		N.A.	
	Drain wire provided for overall shield	Yes, Size- 0.5 sqmm, No of strands-7, Dia of strands- 0.3mm, Annealed Tin coated copper				
	E. FILLERS (if applicable)					
	Non-hygroscopic, flame retardant	To be provided				
	F. OUTER SHEATH					
	Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)	
	Minimum Thickness at any point	1.8 mm			0.4 mm	
	Nominal Thickness at any point	>1.8 mm			0.5 mm	
	Resistant to water, fungus, termite & rodent attack	Required				
	Minimum Oxygen index as per ASTMD-2863	29 %			N.A.	
	Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
	I. CABLE DRUM				
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum.			
	Length	1000 m $\pm$ 5% for up to & including 12 pairs 500 m $\pm$ 5% for above 12 pairs			
Note: Heat resistant instrumentation cable shall have same specification as of G/F type instrumentation cable as specified above, except that insulation and outer sheath material shall be Teflon and cable shall be suitable for continuous operation at 205 Deg. C					
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2		SUB-SECTION-III-C4 INSTRUMENTATION CABLES	
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																																					
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.																																																					
4.00.00	SPECIFICATION OF CONTROL & POWER SUPPLY CABLES Refer Electrical sub-sections																																																					
5.00.00	INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A. TABLE A: CABLE TERMINATION TO BE FOLLOWED																																																					
<table><tr><th colspan="2">Application</th><th colspan="2">Type Of Termination</th><th rowspan="2">Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling / Marshalling – cum Termination Cubicle / local group JB</td><td>Plug in connector</td><td>Post mount cage clamp type.</td><td>G</td></tr><tr><td>Transmitters, Process Actuated switches mounted in LIE/LIR</td><td>Integral Junction box of LIE/LIR</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD heads</td><td>Local junction box</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F</td></tr><tr><td>Thermocouple</td><td>Local junction box / CJC box (if applicable)</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>A, B, C*</td></tr><tr><td>Other Field mounted Instrument</td><td>Local JB / Group JB</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>F</td></tr><tr><td>Thermocouple</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>A, B, C*</td></tr><tr><td>Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR</td><td>Group JB</td><td>Cage clamp (Rail mount) type.</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr></table>						Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B	Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F	Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*	Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Application		Type Of Termination		Type Of Cable
	FROM (A)	TO (B)	END A	END B	
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connect or at one end)
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard
Notes 1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard. 2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided. 3 * For high temperature applications only. 4 . For connection between field/JB and DDCMIS marshalling cabinet Minimum 4 pair instrumentation cable shall be used. 5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end. 6 Not used.					
6.00.00	TERMINAL BLOCKS				
6.01.00	All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post				
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CLAUSE NO.	TECHNICAL REQUIREMENTS								
	mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.								
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.								
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.								
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.								
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.								
7.00.00	INTERNAL PANELS/ SYSTEM CABINETS WIRING								
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.								
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.								
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.								
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.								
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.								
7.06.00	Wire sizes to be utilised for internal wiring. <table><tr><td>(i)</td><td>Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.</td><td>0.5 Sq.mm.</td></tr><tr><td>(ii)</td><td>Power supply and internal illumination.</td><td>2.5Sq.mm. minimum (shall be as per load requirement.)</td></tr></table>			(i)	Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.	(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)
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CLAUSE NO.	TECHNICAL REQUIREMENTS																				
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows: <table><tr><td>From 11 kV/6.6 kV/3.3 kV tray system</td><td>-</td><td>914 mm</td></tr><tr><td>From 415V tray system</td><td>-</td><td>610 mm</td></tr><tr><td>From control cable tray system</td><td>-</td><td>305 mm</td></tr></table>			From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	From 415V tray system	-	610 mm	From control cable tray system	-	305 mm									
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8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.																				
8.04.00	Not in use																				
8.05.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.																				
9.00.00	CABLE LAYING AND ACCESSORIES																				
9.01.00	CABLE LAYING <table><tr><td>1</td><td colspan="2">Cables shall be laid strictly in line with cable schedule.</td></tr><tr><td>2</td><td colspan="2">Identification tags for cables. Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.</td></tr><tr><td>3</td><td colspan="2">Cable tray numbering and marking. To be provided at every 10m and at each end of cable way & branch connection.</td></tr><tr><td>4</td><td colspan="2">No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.</td></tr><tr><td>5</td><td colspan="2">Buried cable protection With concrete slabs; Route markers at every 20 Meters along the route & at every bend.</td></tr><tr><td>6</td><td colspan="2">Road Crossings Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between - HT power & LT power cables, - LT power & LT control/instrumentation cables, </td></tr></table>			1	Cables shall be laid strictly in line with cable schedule.		2	Identification tags for cables. Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.		3	Cable tray numbering and marking. To be provided at every 10m and at each end of cable way & branch connection.		4	No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.		5	Buried cable protection With concrete slabs; Route markers at every 20 Meters along the route & at every bend.		6	Road Crossings Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between - HT power & LT power cables, - LT power & LT control/instrumentation cables,	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	Page 102 of 100	
	Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing. 7 Segregation (physical isolation to prevent fire jumping) a All cable associated with the unit shall be segregated from cables of other Units. b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. 8 Cable clamping All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided. 9 Optical fiber cables (OFCs) : Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure Inside Building Area – to be laid on separate cable sub-trays While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor; While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe. 10 Laying of Network Cable (UTP/STP) : Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure. Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.		
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.		
9.03.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.		
9.04.00	The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.		
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9.05.00	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.		
10.00.00	FIELD MOUNTED LOCAL JUNCTION BOXES		
	(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
	(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
	(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.
	(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.
	(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm ² . A M6 earthing stud shall be provided.
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
	(vii)	Grounding	To be provided.
	(viii)	Color	RAL 7035
11.00.00	CONDUITS		
11.01.00	Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant terne coated steel with , water leak, fire and rust proof protected <i>for the areas of Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's</i> . <i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.</i> The temperature rating of flexible conduit shall be suitable for actual application.		
11.02.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.		
11.03.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.		
11.04.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2	SUB-SECTION-III-C4 INSTRUMENTATION CABLES PAGE 12 OF 13

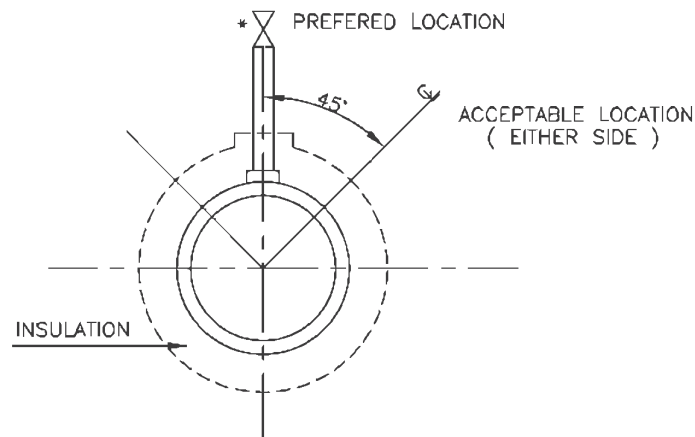
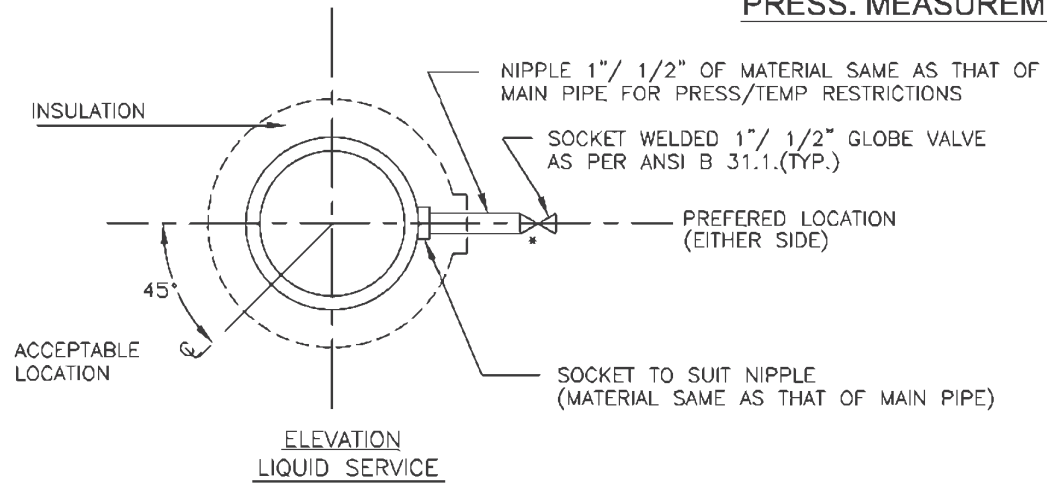
Page 20 of 30		
CLAUSE NO.	TECHNICAL REQUIREMENTS	
	utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.	
11.05.00	Conduits shall be securely fastened to all boxes and cabinets.	
12.00.00	CABLE SUB-TRAY & SUPPORT	
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).	
12.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded.	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2
		SUB-SECTION-III-C4 INSTRUMENTATION CABLES
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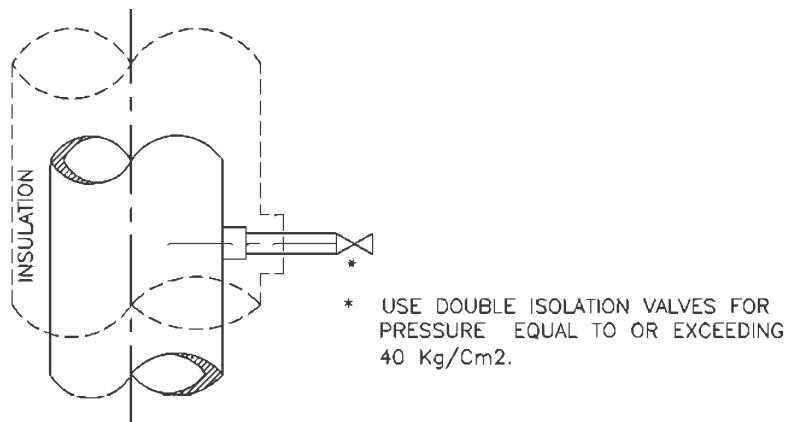
**C&I SPECIFICATION FOR
GYPSUM DEWATERING EQUIPMENT**

SECTION: C
SUB SECTION: C&I

INSTRUMENT STUB DETAILS



**ELEVATION
STEAM SERVICE**
PRESSURE CONNECTION ON HORIZONTAL PIPE

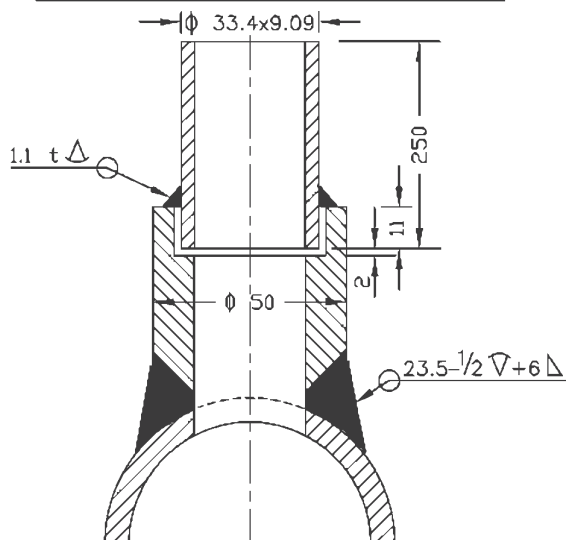


**ELEVATION
LIQUID OR STEAM SERVICE**
PRESSURE CONNECTIONS ON VERTICAL PIPES

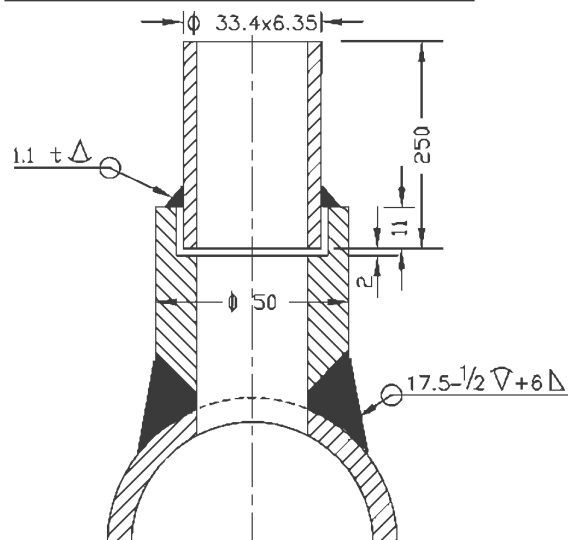
FOR TENDER PURPOSE ONLY

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PROJECT TYPICAL THERMAL POWER PROJECT													
TITLE INSTRUMENT SOURCE CONNECTION DETAILS													
A	FIRST ISSUE	DESIGN	CHKD.	M	E	C	CM	ARCH.	APPD.	DATE			
REV. NO.	DESCRIPTION	Cleared By								SIZE A4	SCALE N.T.S.	DRG. NO. 0000-999-POI-A-035	REV. NO. A
										Sh-1 Of 14			

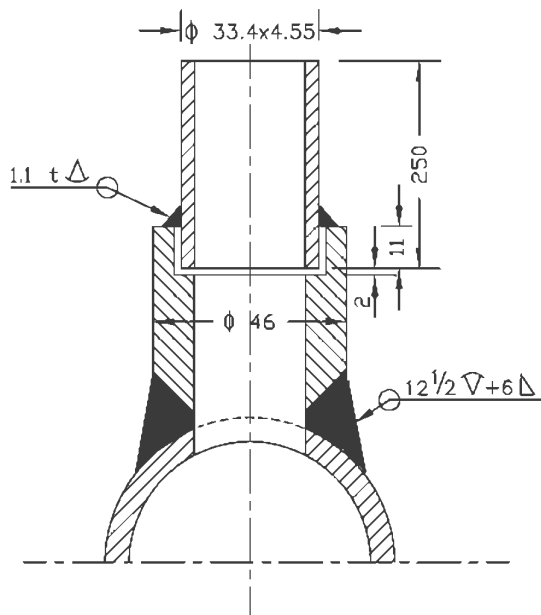
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



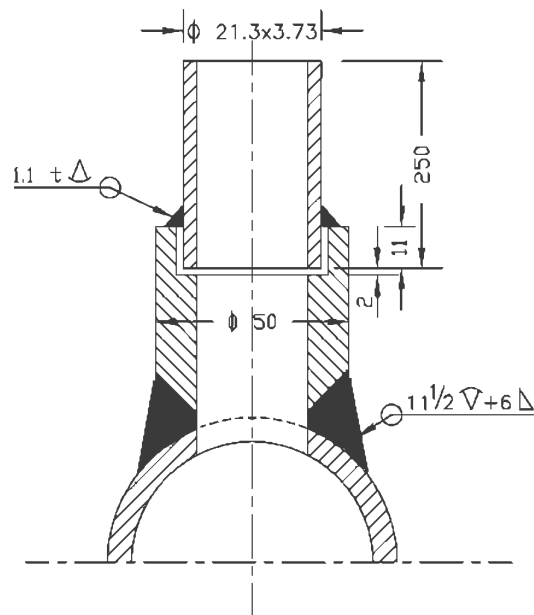
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)

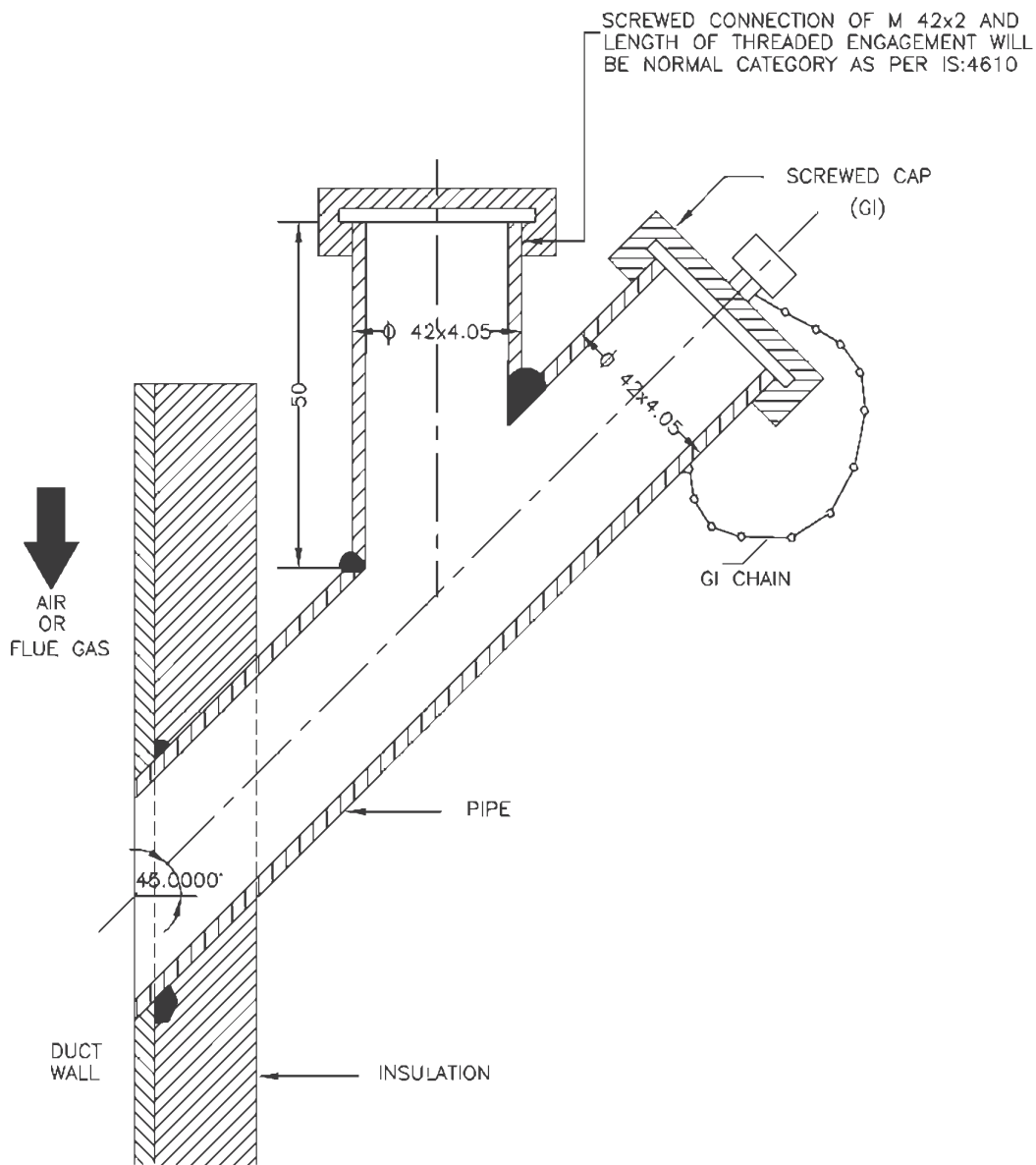


1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = $>40 \text{ Kg/Cm}^2$.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64"$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">A</td> <td style="width: 45%;">FIRST ISSUE</td> <td style="width: 5%; text-align: center;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;">T.G.</td> <td style="width: 5%;"></td> <td style="width: 5%; text-align: right;">REV. DATE</td> </tr> <tr> <td>REV. NO.</td> <td>DESCRIPTION</td> <td>DRAWN</td> <td>DESIGN</td> <td>CHKD.</td> <td>W</td> <td>E</td> <td>C</td> <td>CAL</td> <td>ARCH.</td> <td>APFD.</td> <td>DATE</td> </tr> <tr> <td colspan="12" style="text-align: center;">Cleared By</td> </tr> </table>										A	FIRST ISSUE								T.G.		REV. DATE	REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	W	E	C	CAL	ARCH.	APFD.	DATE	Cleared By												<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">SIZE</td> <td style="width: 15%;">SCALE</td> <td style="width: 15%;">DRG. NO.</td> <td style="width: 45%;">0000-999-POI-A-035</td> <td style="width: 10%; text-align: right;">REV. NO.</td> </tr> <tr> <td>A4</td> <td>N.T.S.</td> <td></td> <td></td> <td>A</td> </tr> <tr> <td colspan="5" style="text-align: right;">Sh-2 of 14</td> </tr> </table>		SIZE	SCALE	DRG. NO.	0000-999-POI-A-035	REV. NO.	A4	N.T.S.			A	Sh-2 of 14				
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PRESS. MEASUREMENT



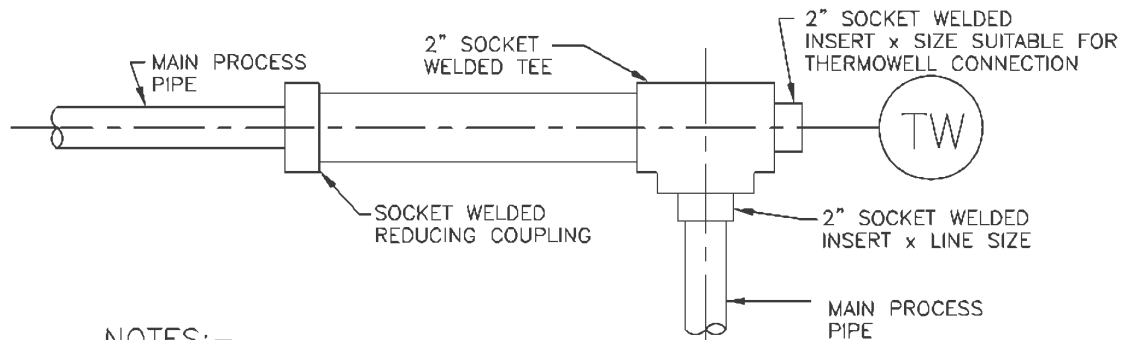
NOTES:-

1. THIS TYPE OF PRESSURE CONNECTION SHALL BE PROVIDED FOR PRESSURE MEASUREMENTS IN AIR AND FLUE GAS DUCT/FURNACE.
2. DIMENSIONS ARE INDICATIVE ONLY.

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PROJECT TYPICAL THERMAL POWER PROJECT									
TITLE INSTRUMENT SOURCE CONNECTION DETAILS									
A	FIRST ISSUE						T.G.		21.09.10
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	CM	ARCH.
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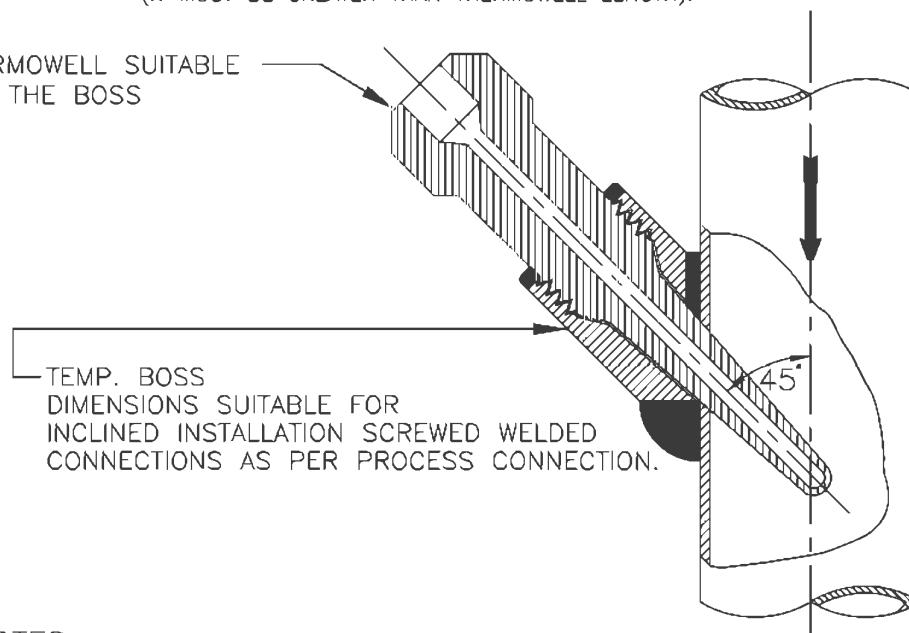
TEMP. MEASUREMENT



NOTES:—

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).

THERMOWELL SUITABLE FOR THE BOSS

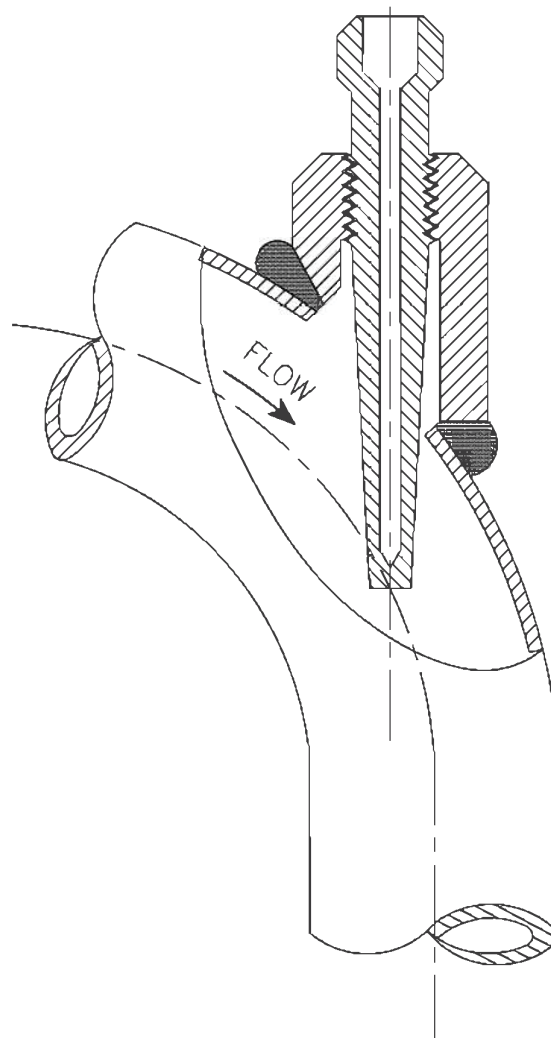


NOTES:—

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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PROJECT: TYPICAL THERMAL POWER PROJECT (SG PACKAGE)															
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS															
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	CM	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
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NOTES:—

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

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