

**NABINAGAR POWER GENERATING COMPANY PRIVATE LIMITED
(NPGCP LIMITED)**

3x660 MW NABINAGAR STPP

TECHNICAL SPECIFICATION

FOR

GYPSUM DEWATERING SYSTEM
(VACUUM BELT FILTER TYPE)

SPECIFICATION NO.: PE-TS-457-571-A101



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



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION

REV. 00

SHEET : 1 OF 2

CONTENTS

SECTION - I

SUB- SECTIONS	TITLE	Page No.
Sub-Section-A	INTENT OF SPECIFICATION	2 - 4
Sub-Section-B	PROJECT INFORMATION	5-19
Sub-Section-C	TECHNICAL SPECIFICATIONS	
Sub Section-C1	SPECIFIC TECHNICAL REQUIREMENT	21-39
Sub Section-C2	CUSTOMER SPECIFICATION	
	C2 - A PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING: FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES GENERAL TECHNICAL REQUIREMENT QUALITY ASSURANCE DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE PACKING PROCEDURE	40-142
	C2 - B PAINTING SPECIFICATION	
Sub Section-C3	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)	143-182
Sub Section-C4	TECHNICAL SPECIFICATION (C&I PORTION)	183-353
Sub Section-D	ANNEXURE-I LIST OF MAKES OF SUB-VENDOR ITEMS	354
	ANNEXURE-II MANDATORY SPARE LIST	355-360
	ANNEXURE-III INSPECTION AND TESTING, QUALITY PLAN	361-381
	ANNEXURE-IV INPUT DRAWINGS (PID/ MECHANICAL LAYOUT DRAWINGS SHOWING LOCATION OF EQUIPMENT/ PLOT PLAN)	382-430
	ANNEXURE-V MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	431-436
	ANNEXURE-VI PACKING PROCEDURE	437-440
	ANNEXURE-VII SEA-WORTHY PACKING PROCEDURE	441-493
	ANNEXURE-VIII PIPE & VALVE MATERIAL SPECIFICATION	494-499

SECTION - II

SUB SECTIONS	TITLE	Page No.
Sub Section-1	STANDARD TECHNICAL REQUIREMENTS	500-504



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION

REV. 00

SHEET : 2 OF 2

SECTION - III

SUB SECTIONS	TITLE	Page No.
Annexure-1	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	505
Annexure-2	COMPLIANCE CUM CONFIRMATION CERTIFICATE	506-507
Annexure-3	PRE BID CLARIFICATION SCHEDULE	508
Annexure-4	DEVIATION SHEET (COST OF WITHDRAWAL)	509
Annexure-5	SCHEDULE OF GUARANTEES	510-511
Annexure-6	LIST OF MAKES OF SUB VENDOR ITEMS	512
Annexure-7	LIST OF TOOLS & TACKLES	513
Annexure-8	EQUIPMENT DATA SHEET/ SCHEDULE (TO BE FILLED BY BIDDER)	514-521
Annexure-9	LIST OF COMMISSIONING SPARES	522



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM

SPECIFICATION No: PE-TS-457-571-A101

SECTION: I

REV. 00

SECTION - I



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
INTENT OF SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

Sub Section: A

REV. 00

SHEET 1 OF 3

SECTION-I
SUB-SECTION-A
INTENT OF SPECIFICATION



3x660 MW NABINAGAR STPP
GYPHUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
INTENT OF SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A101
SECTION : I
Sub Section: A
REV. 00
SHEET 2 OF 3

1.0 INTENT OF SPECIFICATION

- 1.1 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, 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/ client O&M staff covering all aspects of the GDS-Operation & Maintenance (6 days) at Site, training of customer's personnel at manufacturer's works (6 mandays including lodging and boarding) & handover in flawless condition of the package 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 for Flue Gas Desulphurization (FGD) plant of **3x660 MW Nabinagar STPP, Aurangabad, Bihar** of M/s Nabinagar Power Generating Company Private Limited (NPGCPL).
- 1.2 There are three (3) units of each 660 MW and each unit is envisaged with one (1) FGD system. Two (02) Sets of Gypsum Dewatering system (1 working + 1 standby) common for all three units 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 complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **GYPHUM DEWATERING SYSTEM**.
- 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 system for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

	3x660 MW NABINAGAR STPP GYP SUM DEWATERING SYSTEM TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-457-571-A101	
		SECTION : I	
		Sub Section: A	
		REV. 00	
		SHEET 3 OF 3	

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 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 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).



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
PROJECT INFORMATION

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

Sub Section : B

REV. 00

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION			
1.00.00	BACKGROUND A Joint Venture Agreement was signed between NTPC and BSEB/ Govt. of Bihar on 14.02.2008 for Establishment and Operation & Maintenance of 3x660 MW capacity coal based thermal power project near Nabinagar Distt Aurangabad Bihar and thereafter a Joint Venture company namely, Nabinagar Power Generating Company Private Limited (NPGCPL) was incorporated with equity structure of 50% each by NTPC and BSEB on 09.09.2008. The project shall be a mega project and shall be implemented during XII Plan period.			
1.01.00	Location The plant is located in Aurangabad district of Bihar at a distance of about 15 kms. from Barun in Aurangabad district of Bihar and is approachable from NH-2 through a 20 kms (approx.) long single lane metalled road. The Aurangabad city is about 55 kms. from project site. Nearest railway station is Ankorha on Sone – Garwa Road Section of Eastern Central Railway at about 1.0 Kms. from the project site. Airport The nearest airport at Gaya is at a distance of about 120 Kms from project site. The distances of site from Patna Airport and Varansi Airport are about 250 Kms & 220 Kms respectively. Vicinity plan of the proposed project is placed at Annexure -I			
1.02.01	Land About 2500 acres of land required for the project (main plant, township, ash disposal areas and corridors etc.) has been identified. Govt. of Bihar have accorded in-principle clearance for availability of land vide letter dated 15.06.2007 and 27.02.2009.			
1.02.02	Coal Coal requirement for the project is estimated about 11.25 million tonnes/annum corresponding to 90% PLF. Likely coal source for the project is North Karanpura coalfields of CCL. Application for Long Term Coal Linkage has been submitted to Ministry of Coal, Govt. of India on 21.06.2007 & 06.10.2008.			
1.02.03	Water The project site is located near the river Sone and the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage on river Son, which is about 3 kms from the proposed site. Make up water requirement for this project would be about 7550 Cu.M/hr with ash water recirculation system and about 8480 Cu.M/hr with once through ash water system.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 1 - OF 31

CLAUSE NO.	PROJECT INFORMATION
1.03.00	Govt. of Bihar has accorded water commitment for availability of 125 cusecs of water vide letter dated 06.06.2007. Railway Siding Employer intends to construct the Railway siding to project site from the nearest existing railway line. However, the same may not be available to the bidder for his use to transport equipment & material. Bidder may visit the site and acquaint themselves with the facilities available.
1.04.00	(i) Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details: The coal quality parameters and Fuel oil Characteristics are indicated in Table-1 & Table-2A & 2B resp. below. Water data (ii) Process water: Source: Terminal point: Process water quality is based on COC given in Table-3. (iii) Clarified water: Terminal point: Clarified water quality is indicated in Table-3. (iv) DM water for Equipment cooling water system. Terminal point: DM water quality is indicated in Table-4.
1.05.00	Steam Generator and ESP data: refer Table-5.
1.06.00	Drawings are enclosed as per Table-6 for initial overview to the Bidder.
2.00.00	NOT USED
3.00.00	Capacity : 3 x 660 MW
4.00.00	Metrological Data Important meteorological data from nearest observatory at Dehri is placed at Annexure -II.
5.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2 SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW) PAGE - 2 - OF 31

CLAUSE NO.	PROJECT INFORMATION														
	of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Steel structures</td><td>:</td><td>2%</td></tr><tr><td>b) Reinforced Concrete structures</td><td>:</td><td>5%</td></tr><tr><td>c) Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr><tr><td>d) Steel stacks</td><td>:</td><td>2%</td></tr></table> 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			a) Steel structures	:	2%	b) Reinforced Concrete structures	:	5%	c) Reinforced Concrete Stacks	:	3%	d) Steel stacks	:	2%
a) Steel structures	:	2%													
b) Reinforced Concrete structures	:	5%													
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LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 3 - OF 31												

CLAUSE NO.	PROJECT INFORMATION			
	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. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2		SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)
PAGE - 4 - OF 31				

CLAUSE NO.	PROJECT INFORMATION			
	<u>APPENDIX – I</u> <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration : 0.16g 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 ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04 b) for braced steel frames designed and detailed as per IS:800 : 0.03 c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024 d) For RCC chimney : 0.08 e) For Liquid retaining tanks : 0.048 d) for Steel chimney and Absorber tower : 0.06 d) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04 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 : 0.08 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 5 - OF 31	

CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																														
	APPENDIX – I HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS In units of 'g' for BRBCL project <table><tr><th rowspan="2">Time Period (Sec)</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>2%</th><th>3%</th><th>5%</th></tr><tr><td>0.000</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.030</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.050</td><td>1.750</td><td>1.607</td><td>1.443</td></tr><tr><td>0.100</td><td>3.737</td><td>3.060</td><td>2.374</td></tr><tr><td>0.104</td><td>3.904</td><td>3.174</td><td>2.443</td></tr><tr><td>0.123</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.150</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.200</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.250</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.300</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.350</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.400</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.450</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.500</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.516</td><td>3.904</td><td>3.401</td><td>2.753</td></tr><tr><td>0.550</td><td>3.662</td><td>3.401</td><td>2.753</td></tr><tr><td>0.600</td><td>3.357</td><td>3.142</td><td>2.753</td></tr><tr><td>0.607</td><td>3.320</td><td>3.105</td><td>2.753</td></tr><tr><td>0.670</td><td>3.006</td><td>2.813</td><td>2.493</td></tr><tr><td>0.700</td><td>2.877</td><td>2.693</td><td>2.386</td></tr><tr><td>0.750</td><td>2.685</td><td>2.513</td><td>2.227</td></tr><tr><td>0.800</td><td>2.518</td><td>2.356</td><td>2.088</td></tr><tr><td>0.850</td><td>2.369</td><td>2.218</td><td>1.965</td></tr><tr><td>0.900</td><td>2.238</td><td>2.094</td><td>1.856</td></tr><tr><td>0.950</td><td>2.120</td><td>1.984</td><td>1.758</td></tr><tr><td>1.000</td><td>2.014</td><td>1.885</td><td>1.670</td></tr><tr><td>1.050</td><td>1.918</td><td>1.795</td><td>1.590</td></tr><tr><td>1.100</td><td>1.831</td><td>1.714</td><td>1.518</td></tr><tr><td>1.150</td><td>1.751</td><td>1.639</td><td>1.452</td></tr><tr><td>1.200</td><td>1.678</td><td>1.571</td><td>1.392</td></tr><tr><td>1.250</td><td>1.611</td><td>1.508</td><td>1.336</td></tr><tr><td>1.300</td><td>1.549</td><td>1.450</td><td>1.285</td></tr><tr><td>1.350</td><td>1.492</td><td>1.396</td><td>1.237</td></tr><tr><td>1.400</td><td>1.439</td><td>1.346</td><td>1.193</td></tr><tr><td>1.450</td><td>1.389</td><td>1.300</td><td>1.152</td></tr><tr><td>1.500</td><td>1.343</td><td>1.257</td><td>1.113</td></tr><tr><td>1.550</td><td>1.299</td><td>1.216</td><td>1.077</td></tr></table>				Time Period (Sec)	Damping Factor (as a percentage of critical damping)			2%	3%	5%	0.000	1.000	1.000	1.000	0.030	1.000	1.000	1.000	0.050	1.750	1.607	1.443	0.100	3.737	3.060	2.374	0.104	3.904	3.174	2.443	0.123	3.904	3.401	2.753	0.150	3.904	3.401	2.753	0.200	3.904	3.401	2.753	0.250	3.904	3.401	2.753	0.300	3.904	3.401	2.753	0.350	3.904	3.401	2.753	0.400	3.904	3.401	2.753	0.450	3.904	3.401	2.753	0.500	3.904	3.401	2.753	0.516	3.904	3.401	2.753	0.550	3.662	3.401	2.753	0.600	3.357	3.142	2.753	0.607	3.320	3.105	2.753	0.670	3.006	2.813	2.493	0.700	2.877	2.693	2.386	0.750	2.685	2.513	2.227	0.800	2.518	2.356	2.088	0.850	2.369	2.218	1.965	0.900	2.238	2.094	1.856	0.950	2.120	1.984	1.758	1.000	2.014	1.885	1.670	1.050	1.918	1.795	1.590	1.100	1.831	1.714	1.518	1.150	1.751	1.639	1.452	1.200	1.678	1.571	1.392	1.250	1.611	1.508	1.336	1.300	1.549	1.450	1.285	1.350	1.492	1.396	1.237	1.400	1.439	1.346	1.193	1.450	1.389	1.300	1.152	1.500	1.343	1.257	1.113	1.550	1.299	1.216	1.077
Time Period (Sec)	Damping Factor (as a percentage of critical damping)																																																																																																																																																														
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0.550	3.662	3.401	2.753																																																																																																																																																												
0.600	3.357	3.142	2.753																																																																																																																																																												
0.607	3.320	3.105	2.753																																																																																																																																																												
0.670	3.006	2.813	2.493																																																																																																																																																												
0.700	2.877	2.693	2.386																																																																																																																																																												
0.750	2.685	2.513	2.227																																																																																																																																																												
0.800	2.518	2.356	2.088																																																																																																																																																												
0.850	2.369	2.218	1.965																																																																																																																																																												
0.900	2.238	2.094	1.856																																																																																																																																																												
0.950	2.120	1.984	1.758																																																																																																																																																												
1.000	2.014	1.885	1.670																																																																																																																																																												
1.050	1.918	1.795	1.590																																																																																																																																																												
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1.350	1.492	1.396	1.237																																																																																																																																																												
1.400	1.439	1.346	1.193																																																																																																																																																												
1.450	1.389	1.300	1.152																																																																																																																																																												
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CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																																		
	APPENDIX – I HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS In units of 'g' for BRBCL project <table><tr><th rowspan="2">Time Period (Sec)</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>2%</th><th>3%</th><th>5%</th></tr><tr><td>1.600</td><td>1.259</td><td>1.178</td><td>1.044</td></tr><tr><td>1.650</td><td>1.221</td><td>1.142</td><td>1.012</td></tr><tr><td>1.700</td><td>1.185</td><td>1.109</td><td>0.982</td></tr><tr><td>1.750</td><td>1.151</td><td>1.077</td><td>0.954</td></tr><tr><td>1.800</td><td>1.119</td><td>1.047</td><td>0.928</td></tr><tr><td>1.850</td><td>1.089</td><td>1.019</td><td>0.903</td></tr><tr><td>1.900</td><td>1.060</td><td>0.992</td><td>0.879</td></tr><tr><td>1.950</td><td>1.033</td><td>0.967</td><td>0.856</td></tr><tr><td>2.000</td><td>1.007</td><td>0.943</td><td>0.835</td></tr><tr><td>2.050</td><td>0.982</td><td>0.920</td><td>0.815</td></tr><tr><td>2.100</td><td>0.959</td><td>0.898</td><td>0.795</td></tr><tr><td>2.150</td><td>0.937</td><td>0.877</td><td>0.777</td></tr><tr><td>2.200</td><td>0.915</td><td>0.857</td><td>0.759</td></tr><tr><td>2.250</td><td>0.895</td><td>0.838</td><td>0.742</td></tr><tr><td>2.300</td><td>0.876</td><td>0.820</td><td>0.726</td></tr><tr><td>2.350</td><td>0.857</td><td>0.802</td><td>0.711</td></tr><tr><td>2.400</td><td>0.839</td><td>0.785</td><td>0.696</td></tr><tr><td>2.450</td><td>0.822</td><td>0.769</td><td>0.682</td></tr><tr><td>2.500</td><td>0.806</td><td>0.754</td><td>0.668</td></tr><tr><td>2.550</td><td>0.790</td><td>0.739</td><td>0.655</td></tr><tr><td>2.600</td><td>0.775</td><td>0.725</td><td>0.642</td></tr><tr><td>2.650</td><td>0.760</td><td>0.711</td><td>0.630</td></tr><tr><td>2.700</td><td>0.746</td><td>0.698</td><td>0.619</td></tr><tr><td>2.750</td><td>0.732</td><td>0.685</td><td>0.607</td></tr><tr><td>2.800</td><td>0.719</td><td>0.673</td><td>0.596</td></tr><tr><td>2.850</td><td>0.707</td><td>0.661</td><td>0.586</td></tr><tr><td>2.900</td><td>0.694</td><td>0.650</td><td>0.576</td></tr><tr><td>2.950</td><td>0.683</td><td>0.639</td><td>0.566</td></tr><tr><td>3.000</td><td>0.671</td><td>0.628</td><td>0.557</td></tr><tr><td>3.050</td><td>0.660</td><td>0.618</td><td>0.548</td></tr><tr><td>3.100</td><td>0.650</td><td>0.608</td><td>0.539</td></tr><tr><td>3.150</td><td>0.639</td><td>0.598</td><td>0.530</td></tr><tr><td>3.200</td><td>0.629</td><td>0.589</td><td>0.522</td></tr><tr><td>3.250</td><td>0.620</td><td>0.580</td><td>0.514</td></tr><tr><td>3.300</td><td>0.610</td><td>0.571</td><td>0.506</td></tr><tr><td>3.350</td><td>0.601</td><td>0.563</td><td>0.499</td></tr><tr><td>3.400</td><td>0.592</td><td>0.554</td><td>0.491</td></tr><tr><td>3.450</td><td>0.584</td><td>0.546</td><td>0.484</td></tr></table>				Time Period (Sec)	Damping Factor (as a percentage of critical damping)			2%	3%	5%	1.600	1.259	1.178	1.044	1.650	1.221	1.142	1.012	1.700	1.185	1.109	0.982	1.750	1.151	1.077	0.954	1.800	1.119	1.047	0.928	1.850	1.089	1.019	0.903	1.900	1.060	0.992	0.879	1.950	1.033	0.967	0.856	2.000	1.007	0.943	0.835	2.050	0.982	0.920	0.815	2.100	0.959	0.898	0.795	2.150	0.937	0.877	0.777	2.200	0.915	0.857	0.759	2.250	0.895	0.838	0.742	2.300	0.876	0.820	0.726	2.350	0.857	0.802	0.711	2.400	0.839	0.785	0.696	2.450	0.822	0.769	0.682	2.500	0.806	0.754	0.668	2.550	0.790	0.739	0.655	2.600	0.775	0.725	0.642	2.650	0.760	0.711	0.630	2.700	0.746	0.698	0.619	2.750	0.732	0.685	0.607	2.800	0.719	0.673	0.596	2.850	0.707	0.661	0.586	2.900	0.694	0.650	0.576	2.950	0.683	0.639	0.566	3.000	0.671	0.628	0.557	3.050	0.660	0.618	0.548	3.100	0.650	0.608	0.539	3.150	0.639	0.598	0.530	3.200	0.629	0.589	0.522	3.250	0.620	0.580	0.514	3.300	0.610	0.571	0.506	3.350	0.601	0.563	0.499	3.400	0.592	0.554	0.491	3.450	0.584	0.546	0.484
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LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 7 - OF 31																																																																																																																																																															

CLAUSE NO.	PROJECT INFORMATION			
6.00.00	<u>APPENDIX – I</u> <u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u> In units of 'g' for BRBCL project			
	Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
		2%	3%	5%
	3.500	0.575	0.539	0.477
	3.550	0.567	0.531	0.470
	3.600	0.559	0.524	0.464
	3.650	0.552	0.516	0.458
	3.700	0.544	0.509	0.451
	3.750	0.537	0.503	0.445
	3.800	0.530	0.496	0.439
	3.825	0.527	0.493	0.437
	3.850	0.523	0.490	0.434
	3.900	0.516	0.483	0.428
	3.950	0.510	0.477	0.423
	4.000	0.504	0.471	0.418
	<u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u> All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovaling 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			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2		SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)
				PAGE - 8 - OF 31

CLAUSE NO.	PROJECT INFORMATION																	
	factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures</td><td>: 2.0%</td></tr><tr><td>c) Reinforced concrete structures</td><td>: 1.6%</td></tr><tr><td>d) Steel stacks</td><td>: As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table> <u>ANNEXURE-B</u> <u>SITE SPECIFIC DESIGN PARAMETERS</u> The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: <table><tr><td>a) The basic wind speed "V_b" at ten</td><td></td></tr><tr><td>b) The risk coefficient "K₁"</td><td>: 1.07</td></tr><tr><td>c) Category of terrain</td><td>: Category-2</td></tr></table>				a) Welded steel structures	: 1.0%	b) Bolted steel structures	: 2.0%	c) Reinforced concrete structures	: 1.6%	d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.	a) The basic wind speed "V _b " at ten		b) The risk coefficient "K ₁ "	: 1.07	c) Category of terrain	: Category-2
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a) The basic wind speed "V _b " at ten																		
b) The risk coefficient "K ₁ "	: 1.07																	
c) Category of terrain	: Category-2																	
7.00.0	FOUNDATION SYSTEM AND GEOTECHNICAL DATA																	
7.00.01	Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.																	
7.00.02	The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.																	
7.00.03	The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable.																	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 9 - OF 31														

CLAUSE NO.	PROJECT INFORMATION			
7.00.04	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drain and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 10 - OF 31

CLAUSE NO.	PROJECT INFORMATION																														
	ANNEXURE – I EXHIBIT - 1 N PLANT & ASH DISPOSAL AREA ANKORHA RS MAJHIYAN MAHIRAWAN SON RIVER INDRAPURI COLONY TILOTHU BARUN SASARAW BARUN DALTENGRA BRANCH HUSAINABAD NABINAGAR TPC-RLY JV PROJECT PLANT AREA 84° 05' 84° 10' 24° 24° 45' Nabinagar Power Generating Com. Pvt Ltd. NTPC Limited (A Govt. of India Enterprise) <table><tr><th>PREP. BY</th><th>CKD BY</th><th>APP. BY</th><th>DATE</th><th>SCALE</th><th>PROJECT :</th></tr><tr><td>BS</td><td>PK</td><td>DM</td><td>22-05-09</td><td></td><td>NABINAGAR STPP (3x660 MW)</td></tr><tr><td colspan="5"></td><td>TITLE : VICINITY PLAN</td></tr><tr><td colspan="5"></td><td>DRG.NO. : REV</td></tr><tr><td colspan="5"></td><td>0370:601:NOG:W:001 0</td></tr></table>	PREP. BY	CKD BY	APP. BY	DATE	SCALE	PROJECT :	BS	PK	DM	22-05-09		NABINAGAR STPP (3x660 MW)						TITLE : VICINITY PLAN						DRG.NO. : REV						0370:601:NOG:W:001 0
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LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO..CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 22 - OF 31																												

CLAUSE NO.	PROJECT INFORMATION			
	Table-3			
	S.No	Constituent	As	mg/l (except pH & turbidity)
	1.	Calcium	CaCO ₃	131
	2.	Magnesium	CaCO ₃	52
	3.	Sodium + Potassium	CaCO ₃	65
	4.	Total Cations	CaCO ₃	248
	5.	Chloride	CaCO ₃	20
	6.	Sulphate	CaCO ₃	93
	7.	Nitrate	CaCO ₃	10
	8.	Alkalinity	CaCO ₃	125
	9.	Total Anions	CaCO ₃	248
	10.	Iron(total)	Fe	0.3
	11.	Total Silica	SiO ₂	22
	12.	pH value	---	7.0-8.2
	13.	Turbidity	NTU	10
Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dosing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.				
Table-4				
ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER				
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 0.1 micro mhos/cm excluding the effects of free CO2		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.:CS-0011-109(1A)-2	SUB SECTION-II-A8 PROJECT INFORMATION NABINAGAR STPP-I (3X660MW)	PAGE - 29 - OF 31



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

Sub Section : C

REV. 00

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATION



3X660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C1

REV. 00

SHEET 1 OF 19

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

SUB-SECTION : C1

SPECIFIC TECHNICAL REQUIREMENT

REV. 00

SHEET 2 OF 19

1.1 FUNCTION

The purpose of the specification is to provide complete Gypsum Dewatering System (GDS) for 3X660 MW NABINAGAR STPP, under the scope of this tender.

1.2 TECHNICAL INFORMATION

1.2.1	Quantity of gypsum dewatering System	Two (2) Set (one working +one standby)
1.2.2	Capacity of gypsum dewatering system	65.3 Tones per hour (wet cake) minimum at outlet of Vacuum belt filter for each belt filter
1.2.3	Moisture content	10 (Max) %
1.2.4	Gypsum purity	≥ 90%
1.2.5	Chloride content	< 100 ppm

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, 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/ client O&M staff covering all aspects of the GDS- Operation & Maintenance, Troubleshooting etc., training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance (6 days) at Site, training of customer at manufacturer's works (6 mandays including lodging and boarding) & 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/ client O&M staff covering all aspects of the GDS- Operation & Maintenance (6 days) at Site, training of customer at manufacturer's works (6 mandays including lodging and boarding) & handover in flawless condition of the package to the customer.

2.1.1 The scope of supply for Gypsum Dewatering System shall include but not limited to the following:

- 2.1.1.1 Primary hydro cyclone: Two (2) sets
- Hydrocyclone clusters
 - Anchor bolts, nuts and washers

	3X660 MW NABINAGAR STPP		SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT		SECTION : I	
			SUB-SECTION : C1	
			REV. 00	
			SHEET 3 OF 19	
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, 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 (4 nos., 2 nos./receiver tank: 1 working + 1 stand by) shall be provided. Refer Scheme No. PE-FEP-00 for the typical Scheme of the 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/NPGCPL.				
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 sump pumps (2 nos., 1 working + 1 stand by) in his 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, 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/NPGCPL.				
2.1.1.6 Vent fan including enclosure and its arrangement: Two (2) numbers				

	3X660 MW NABINAGAR STPP		SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT		SECTION : I	
			SUB-SECTION : C1	
			REV. 00	
			SHEET 4 OF 19	
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 as per the P&ID no. 0370-109-PVM-F-020 Sheet 7, 8, 9 & 10. 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 tank(s) supply with inlet/outlet nozzle is in BHEL scope. Instrumentation on tank(s) is excluded from the bidder scope. Inlet piping along with associated instruments/ valves from process water Terminal point to the tanks inlet nozzles, Process 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 system – 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 e. Process water piping from TP outside building to wash tanks. f. Instrument air piping from TP outside building up to equipment related to the system (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 system is limited to engineering only and supply shall be made by BHEL. Engineering 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				

	3X660 MW NABINAGAR STPP		SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT		SECTION : I	
			SUB-SECTION : C1	
			REV. 00	
			SHEET 5 OF 19	
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 drain of vacuum belt filters to filtrate tank g. overflow and drain piping of cake wash tanks and cloth wash tanks. 2.1.1.10 Instruments/Valves for the entire gypsum dewatering system including integral piping as defined at 2.1.1.9 above (minimum requirement for each gypsum dewatering system is given in the P&ID): One (1) set* 2.1.1.11 Electric common including but not limited to i. Local control panel, if required ii. LV, HT Motors (as applicable) iii. Junction Box iv. Instruments v. Push buttons 2.1.1.12 Expansion Joints at suction and discharge of each pump/other equipment, as applicable: One (1) Set* 2.1.1.13 All motors shall be provided with suitable double compression cable gland. Bidder shall provide cable glands and lugs for all equipment in his scope. Cables shall be terminated using double compression type cable glands and solder less 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. 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 2.1.1.15.1 Alarm Signal: a) Bearing temperature high 2.1.1.15.2 Interlock signal: a) Belt filter wash tank level low b) Cake wash tank level low				

	3X660 MW NABINAGAR STPP		SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT		SECTION : I	
			SUB-SECTION : C1	
			REV. 00	
			SHEET 6 OF 19	
Bearing Temperature Transmitter for initiating alarm during when “Bearing temperature high” shall be supplied by Bidder. 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. Similarly, Vibration transmitters (with 2V3 logic) for measuring vibration in X & Y axis have to be provided for at the driving and Non-driving end for HT Motors. 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 contractor/supplier. Refer Clause 7.0 of this sub-section for details. 2.1.1.17 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 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: (i) Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL. (ii) Supervision for Erection & Commissioning, trial run at site (iii) Performance guarantee tests at site & handover in flawless condition of the package to the customer (iv) training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance (6 days) at Site (v) Training of customer at manufacturer’s works (6 man-days) including lodging and boarding) (vi) Visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site for supervision services. Bidder shall be informed at least 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 by them. 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 (is not part of scope of supply) 2.1.5 Any other items required not covered above but required for the completeness of the system; it shall be included in the offer and shall be supplied by the Bidder/supplier. Bidder shall refer to the P&ID 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&ID are minimal requirements. *Wherever (*) is marked, one (1) set means complete requirement for both the gypsum dewatering system.				



3X660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C1

REV. 00

SHEET 7 OF 19

2.2 PROCESS DESCRIPTION

1. Common gypsum dewatering system is envisaged for all three units. The dewatering system shall receive the gypsum slurry from Primary Hydro cyclone feed pumps (BHEL Scope). Gypsum dewatering system shall be suitable for handling slurry from all three FGD units. Two sets of primary hydrocyclone (1W+1S) with accessories shall be in vendor 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 vendor 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 water & instrument air will be provided at one location, located at 5 m from building boundary. Further piping from terminal point to GDS system utilities are in bidder's scope.
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 GDS building for the details in the scope.

2.4 For Electrical scope, refer Electrical specification (Sub-section- C3 of Section-I).

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

3.0 CODES & STANDARDS AND OTHER REQUIREMENTS

3.1 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

	3X660 MW NABINAGAR STPP	SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SECTION : I	
		SUB-SECTION : C1	
		REV. 00	
		SHEET 8 OF 19	
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. 3.2 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 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 3.3 Other International/ National standards such as DIN, VDI, 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.			

	3X660 MW NABINAGAR STPP	SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SECTION : I	
		SUB-SECTION : C1	
		REV. 00	
		SHEET 9 OF 19	

3.4 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.

3.5 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.

3.6 All items of equipment shall comply with the stipulations of Inspectorate of Factories and other statutory bodies of Government of India and Chief Electrical Inspectorate of the State in which the plant site is located, wherever applicable. Wherever required, the successful bidder has to obtain the necessary approvals from statutory authorities and other concerned agencies. All cost on these accounts shall be borne by the successful Bidder.

4.0	DETAILED TECHNICAL SPECIFICATION
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4.1	DETAILED SPECIFICATION
4.1.1	Bidder shall supply two stage gypsum dewatering system consisting of primary hydro cyclones, vacuum belt filters (VBF) and secondary hydro cyclones for dewatering of gypsum from absorber to less than 10% moisture at the design capacity specified elsewhere in the specification.
4.1.2	Bidder shall supply 2x100% gypsum dewatering system with each stream sized to dewater 65.3 TPH (Wet cake) at outlet of VBF produced by the all three FGD units operating at design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.
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 unit operating at design point.
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 primary hydro-cyclones shall be taken to secondary hydro-cyclone feed.
4.2.4	Two (2) sets of secondary hydro cyclones are to be installed, each set shall be sized to dewater the gypsum slurry produced by all three FGD units operating at design point.
4.2.5	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.
4.2.6	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber, overflow and underflow chamber shall be made of carbon steel of adequate thickness with a rubber lining of minimum 12 mm thickness. Liners shall have a minimum wear life of not less than 7000 hours .
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) numbers of vacuum belt filters each of capacity 65.3 TPH (Wet cake) 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



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

SUB-SECTION : C1

SPECIFIC TECHNICAL REQUIREMENT

REV. 00

SHEET 10 OF 19

	45% or outlet of hydro-cyclones whichever is minimum: ▪ Outlet Moisture: 10% (maximum) ▪ Gypsum Purity: 90% (minimum) ▪ Chloride content: < 100 ppm
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.
4.3.4	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design.
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.
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 P&ID enclosed.
4.3.9	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. 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 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.
4.3.12	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. The elevation of discharge point of vacuum belt filter shall be as per the Gypsum Dewatering Building Drawing provided in the Sub Section-7 of Section-II. Any changes for optimization of the layout shall be suggested by Bidder accordingly.
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 should be in the vendor's scope.
4.3.15	All client end connection flanges shall be ANSI B 16.5/AWWA.



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

SUB-SECTION : C1

SPECIFIC TECHNICAL REQUIREMENT

REV. 00

SHEET 11 OF 19

4.4	Vacuum System
4.4.1	The filtrate from each belt filter, cake washing & cloth washing shall be taken to 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 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 and General Arrangement (GA) of Gypsum dewatering building along with the offer.
4.4.2	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.
4.4.3	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/NPGCPL.
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 PUMP, FILTRATE BELT FILTER, CAKE 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	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.
4.5.3	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.
4.5.4	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.
4.5.5	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.
4.5.6	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.
4.5.7	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. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

SUB-SECTION : C1

REV. 00

SPECIFIC TECHNICAL REQUIREMENT

SHEET 12 OF 19

4.5.8	Design 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.
4.5.9	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).
4.5.10	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.
4.5.11	External flushing is required to remove the accumulated particles and all related information should be mentioned in datasheet.
4.5.12	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.
4.5.13	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.
4.5.14	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.
4.5.15	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.
4.5.16	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.
4.5.17	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
4.5.18	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).
4.5.19	The material and thickness of the liners of slurry 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.
4.5.20	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.
4.5.21	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.
4.5.22	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.
4.5.23	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.



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

SUB-SECTION : C1

SPECIFIC TECHNICAL REQUIREMENT

REV. 00

SHEET 13 OF 19

4.5.24	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.
4.5.25	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
4.5.26	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.
4.5.27	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
4.5.28	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.
4.5.29	Provide double nuts for anchor bolts.
4.5.30	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
4.5.31	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.
4.5.32	Bidder shall provide the mating flanges with the necessary gaskets.
4.5.33	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.
4.5.34	Bidder to provide capacity of crane or hoist required for safe material handling and the details of heaviest component to be handled.
4.5.35	Bidder to provide Pipe & Valve Material as per the Annexure VIII, Sub-Section-D, Section-I of the Specification.
4.5.36	A 1000 mm wide platform with suitable approach shall be provided by the bidder for each hydro cyclone.
4.5.37	A 1500 mm space around all the pumps shall be provided by the bidder.
4.5.38	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.
4.5.39	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.



3X660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C1

REV. 00

SHEET 14 OF 19

5.0 PIPING & INSTRUMENTATION DIAGRAMS (P&IDs)

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

5.1 PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE - OPERATION POINT

Sl. No.	Parameters	Primary Cyclone Slurry	Hydro Feed	Primary Cyclone Flow	Hydro Over	Primary Cyclone Under Flow	Hydro Under
a.	Total Flow (m ³ /hr.)	208.02		120.15 (*1)		87.87 (*1)	
b.	Total Flow (t/hr.)	252.87		133.56 (*1)		119.31 (*1)	
c.	Operating Temp (C)	62.1		62.1		62.1	
d.	Design Temp (C)	70		70		70	
e.	Solid (wt. %)	30		16.6 (*1)		> 45 (*2)	
f.	Density (Kg/m ³)	1216		1112 (*1)		1358 (*1)	
g.	pH	4-7		4-7		4-7	
h.	Cl ⁻ (mg/l)	<22200		<22200		<22200	

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)	120.15 (*1)	75.09 (*1)	45.06 (*1)
b.	Total flow (t/hr)	133.56 (*1)	76.82 (*1)	56.76 (*1)
c.	Operating Temp (°C)	62.1	62.1	62.1
d.	Design Temp (°C)	70	70	70
e.	Solid (% wt.)	> 16.6 (*2)	3 (*2)	35 (*1)
f.	Density (kg/m ³)	1112 (*1)	1023	1260
g.	pH	4-7	4-7	4-7
h.	Cl ⁻ (mg/l)	<22200	<22200	<22200

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)	87.87 (*1)			
b.	Total Flow (t/hr)-Wet	119.31 (*1)	58.77		
c.	Design Temp (°C)	70.0			
d.	Solid (% wt.)	>45 (*2)	>90 (*2)	<0.2	
e.	Density kg/m ³	1358 (*1)			
f.	pH	4~7	5~8		
g.	Cl	<22200	<100 ppm (*2)		
h.	Belt filter and the peripherals shall be designed at 65.3 TPH (wet cake) discharge of product gypsum a. **Quantity of water shall be finalized by the vendor. b. *Property of process(Clarified water) is given below.				
i.	(*1) shall be finalized by vendor. (*2) Shall be guaranteed by vendor.				



3X660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

TECHNICAL SPECIFICATION

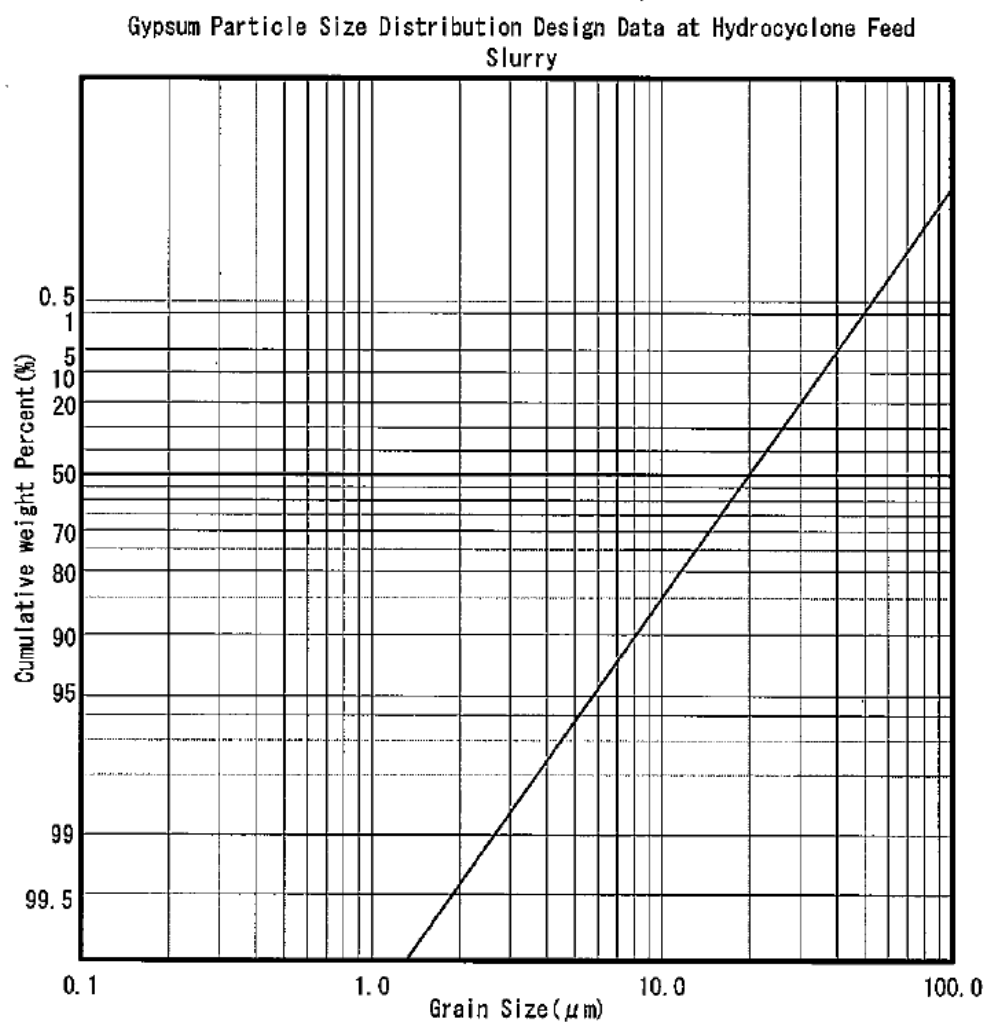
SUB-SECTION : C1

SPECIFIC TECHNICAL REQUIREMENT

REV. 00

SHEET 15 OF 19

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





3X660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

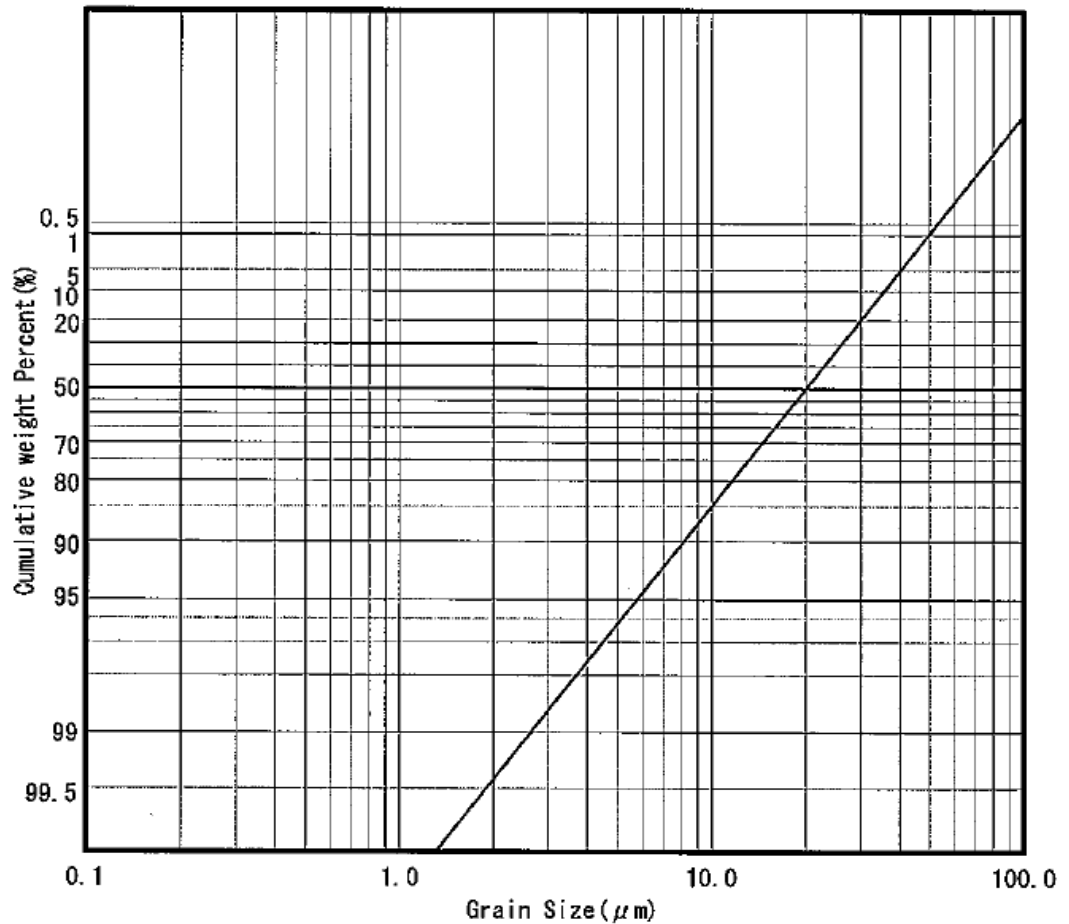
SUB-SECTION : C1

REV. 00

SHEET 16 OF 19

5.5 GYPSUM PARTICLE SIZE AT BELT FILTER FEED SLURRY IS SHOWN BELOW:

Gypsum Particle Size Distribution Design Data at Vacuum Belt Filter Feed Slurry



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	:	229 m ³ /hr each
4.	Secondary hydrocyclone capacity	:	133 m ³ /hr each
5.	Type of hydro cyclone	:	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 under flow chamber	:	CS+12mm rubber lining



3X660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C1

REV. 00

SHEET 17 OF 19

5.7	PROCESS WATER CHARACTERISTICS		
S.No.	Constituents	Unit	Water quality
1.	Calcium as CaCO_3	ppm	131
2.	Magnesium as CaCO_3	ppm	52
3.	Sodium + Potassium as CaCO_3	ppm	65
4.	Iron as Fe	ppm	0.3
5.	Total alkalinity as CaCO_3	ppm	125
6.	Chlorides as CaCO_3	ppm	20
7.	Sulphate as CaCO_3	ppm	93
8.	pH		7.0 – 8.2
9.	Turbidity	NTU	10
10.	Nitrate	ppm	10
11.	Total Anions	ppm	248
12.	Total Cations	ppm	248
13.	Total Silica	ppm	22
Note: Process water will be used for belt cloth and gypsum cake washing.			

	3X660 MW NABINAGAR STPP	SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM	SECTION : I	
		SUB-SECTION : C1	
		REV. 00	
	TECHNICAL SPECIFICATION		
	SPECIFIC TECHNICAL REQUIREMENT	SHEET 18 OF 19	

6.0	SPARES, TOOLS & TACKLES
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6.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the GDS. 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 GDS 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.

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. Wherever the requirement has been specified as a ‘set’ (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as ‘set’ (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. ‘set’ of bearings for a pump would include the total number of bearings in a pump. Also the ‘set’ would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. 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 and indicate the list. 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.

**3X660 MW NABINAGAR STPP****SPECIFICATION No: PE-TS-457-571-A101****GYPSUM DEWATERING SYSTEM****SECTION : I****TECHNICAL SPECIFICATION****SUB-SECTION : C1****SPECIFIC TECHNICAL REQUIREMENT****REV. 00****SHEET 19 OF 19**

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.

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 top-up 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. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.

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

9.0	PAINTS /PAINTING
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Bidder shall follow BHEL/ Customer painting philosophy specified Sub-Section- C2-B Section-I in the specification. An approved painting Schedule (Drawing No. 0370-109-PVM-H-001, R2) is provided. However, for components where no specific requirement is stipulated, the bidder shall follow its standard practice suitable for operating condition and subject to customer approval.

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

- a) All utilities such as instrument air and process water up to terminal point
- b) Control System (excluding Junction box)

11.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION
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Bidder is required to quote GPC in the price schedule issued along with tender.



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

SUB-SECTION : C 2

**TECHNICAL SPECIFICATION
SPECIFIC TECHNICAL REQUIREMENT**

REV. 00

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATION



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

**PROJECT SPECIFIC GENERAL
REQUIREMENTS**

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C 2A

REV. 00

SECTION: I

SUB-SECTION: C 2A

**CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS**

SUB-SECTION-VI

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

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

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2

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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 2 OF 24

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. (ii) For Category-II Guarantees In case during performance guarantee test(s) it is found that the equipment/ system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following: Reject the equipment /system / plant and recover from the Contractor the payments already made. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as "Category-II" Guarantees. 3.00.00 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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 4 OF 24	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES																		
	एनडीपीसी NTPC <u>NABINAGAR JV BIHAR-I (3X660 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>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>US \$ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three 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>For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.</td><td>US \$ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six 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>US \$ 2484/- (US Dollar Two Thousand Four Hundred Eighty Four 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)	For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US \$ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO ₂ removal efficiency.	ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US \$ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US \$ 2484/- (US Dollar Two Thousand Four Hundred Eighty Four 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)	For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US \$ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO ₂ removal efficiency.																
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US \$ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.																
iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US \$ 2484/- (US Dollar Two Thousand Four Hundred Eighty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption																
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 12 OF 24															

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES																		
	<u>NABINAGAR JV RLY-I (4X250 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>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>US \$ 21,045/- (US Dollar Twenty One Thousand Forty Five 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>For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.</td><td>US \$ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four 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>US \$ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine 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)	For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US \$ 21,045/- (US Dollar Twenty One Thousand Forty Five only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO ₂ removal efficiency.	ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US \$ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US \$ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine 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)	For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US \$ 21,045/- (US Dollar Twenty One Thousand Forty Five only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO ₂ removal efficiency.																
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US \$ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.																
iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US \$ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption																
	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) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.																		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 15 OF 24															

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
4.00.00 4.01.00	iii) 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) iv) 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. v) The LD values are applicable on per unit basis. GUARANTEES PARAMETERS Guarantees Under Category-I The Performance Guarantees which attract Liquidated Damages (LD) are as follows: The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI: (i) SO₂ removal Efficiency The Contractor shall Guarantee that SO₂ removal efficiency at guarantee point (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 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 of FGD system Limestone consumption of FGD system in kg/hr under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) and SO₂ removal efficiency of not less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) (iii) Auxiliary Power Consumption The Contractor shall guarantee the total auxiliary power consumption for the FGD plant in normal operation at the guarantee point conditions, as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project, inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 16 OF 24

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
4.02.00	Guarantees Under Category-II The parameters/capabilities shall be demonstrated for various systems/equipments shall include but not limited to the following:- (i) Wet ball Mill capacity at rated fineness The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions: i) Limestone fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh. ii) Limestone Quality : All available quality from the specified range. (ii) Wet ball Mill wear parts guarantee Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation. (iii) Wet ball Mill ball consumption Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced. (iv) Vacuum Belt Filter Capacity Contractor shall demonstrate the Designed Capacity of the Vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification. (v) Gypsum Purity The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for guarantee point condition.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 17 OF 24

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC
	(vi) Waste Water The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10m³/hr averaged over a 24 hour period from each unit. (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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 18 OF 24

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) Waste Water Treatment System (Applicable for Barh-I (3X660 MW) & Nabinagar (4x250 MW)) The Contractor shall guarantee the followings. A). Wastewater treatment capacity(m³/hr) : ≥ 30 for Barh-I (3X660 MW) B). Wastewater treatment capacity(m³/hr) : ≥ 20 for Nabinagar (4x250 MW) C). Operating time : 16hr for Pre-treatment process, 24hr for Evaporation process D). The distillate quality (Evaporator and crystallizer combined) shall be a maximum of 50 ppm TDS at 120 °F, while the solids produced for disposal which will pass the paint filter test.			
	AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT The unit auxiliary power consumption shall be calculated using the following relationship. $P_a = P_u + T_L$ P_a = Guaranteed Auxiliary Power Consumption. P_u = Power consumed by the auxiliaries of the unit under test. T_L = 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:			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 20 OF 24

CLAUSE NO.		FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES		एनटीपीसी NTPC	
		Drives (indicative list) are marked to be considered by the Bidder for guaranteeing the power consumption.			
		iii.	Absorber Oxidation Tank Agitator(s)		
		iv.	Gypsum Bleed Pump		
		v.	Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project		
		vi.	Limestone Slurry Pump		
→		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 Booster water pump (if provided) divided by the number of units in the project.		
		ix.	Process water pump(s) divided by the number of units in the project		
		x.	Mist Eliminator Wash Water pump(s)		
→		xi.	Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project		
		xii.	DM Cooling (normally working) Water pump one(1) to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system.		
		xiii.	Auxiliary Cooling (normally working) water pump one(1) to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.		
		xiv.	Booster Fans		
		xv.	Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project		
		xvi.	Power consumption of Filtrate Pump divided by the number of units in the project		
Same as xi.		xvii.	Power consumption of Belt Filter Wash Water Pump 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		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2		SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	
				PAGE 21 OF 24	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	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 and ZLD Control Room Building (if provided) 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 air washer units and at an elevation of RL (+) - m for both AHUs and Air washer unit 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 Evaporator feed pump divided by the number of units in the project, in case ZLD system is provided xxv. Power consumption of Evaporator/Brine concentrator recirculation pump divided by the number of units in the project, in case ZLD system is provided xxvi. Power consumption of Distillate pump divided by the number of units in the project, in case ZLD system is provided xxvii. Power consumption of Crystalliser feed pump divided by the number of units in the project, in case ZLD system is provided xxviii. Power consumption of Crystalliser recirculation pump divided by the number of units in the project, in case ZLD system is provided xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the project, in case ZLD system is provided 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			
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 22 OF 24	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
6.00.00 7.00.00	consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption. Note : - The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval. - The equipments 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. METHOD OF COMPUTING TEST EFFICIENCY OF FGD The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the test shall, however be mutually agreed upon between the employer and the contractor. METHOD OF COMPUTING AVAILABILITY The Contractor shall guarantee 98 % availability of FGD plant including waste water treatment system for Zero Liquid Discharge (ZLD), wherever provided, for a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure indicated below. Availability 'A' in %: $A = \frac{T_c \times 100\%}{T_k}$ T_c – recorded time of FGD operation, expressed in hours, T_k – recorded time of boiler operation, expressed in hours, However, it is required that: - In order to calculate the FGD availability, operation hours will be counted except boiler start-ups when the operation hours counting will start on the moment of shut down of all oil burners, - FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO₂			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 23 OF 24	

NTPC Limited

(A Government of India Enterprise)



LOT-IA PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(1A)-2

PART - C

GENERAL TECHNICAL REQUIREMENTS

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

TECHNICAL SPECIFICATION
SECTION-VI, PART-C
BID DOC NO: CS-0011-109(1A)-2

GENERAL TECHNICAL REQUIREMENTS

PART - C

CONTENTS

Clause No.	Description	Page No.
1.00.00	Introduction	1
2.00.00	Brand Name	1
3.00.00	Base Offer & Alternate Proposals	1
4.00.00	Completeness of Facilities	1
5.00.00	Codes & Standards	2
6.00.00	Equipment Functional Guarantee	4
7.00.00	Design of Facilities/ Maintenance & Availability Considerations	5
8.00.00	Documents, Data and Drawings to be furnished by Contractor	5
9.00.00	Technical Co-ordination Meeting	21
10.00.00	Design Improvements	22
11.00.00	Equipment Bases	22
12.00.00	Protective Guards	22
13.00.00	Lubricants, Servo fluids and Chemicals	22
14.00.00	Lubrication	23
15.00.00	Material of Construction	23
16.00.00	Rating Plates, Name Plates & Labels	23
17.00.00	Tools and Tackles	24
18.00.00	Welding	25

Clause No.	Description	Page No.
19.00.00	Colour Code for All equipments/Pipings/PlpeServices	25
20.00.00	Protection and Preserveative shop Coating	25
21.00.00	Quality Assurance Programme	26
22.00.00	General Requirements - Quality Assurance	27
23.00.00	Quality Assurance Documents	32
24.00.00	Project Manager's Supervision	34
25.00.00	Inspection, Testing and Inspection Certificates	35
26.00.00	Pre-commissioning and Commissioning Facilities	38
27.00.00	Taking over	41
28.00.00	Training of Employer's Personnel	41
29.00.00	Safety Aspects during Construction and Erection	42
30.00.00	Noise Level	42
31.00.00	Packaging and Transportation	42
32.00.00	Electrical Equipments/Enclosures	43
33.00.00	Instrumentation and Control	43
34.00.00	Electrical Noise Control	44
35.00.00	Surge protection for solid state equipment	44
36.00.00	Instrument Air System	44
37.00.00	Tapping Points for Measurements	45
38.00.00	System Documentation	45
39.00.00	Maintenance Manuals of Electronic Modules	45

LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-C BID DOC NO: CS-0011-109(1A)-2
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Clause No.	Description	Page No.
	Annexure - I	76
	Annexure - II	77
	Annexure - III	78
	Annexure - IV	79
	Annexure - V	80
	Annexure - VI	81
	Annexure - VII	83
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-C BID DOC NO: CS-0011-109(1A)-2

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.			
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.			
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 1 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	RULES, REGULATIONS, CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following: a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976,			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 2 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
5.02.00	(p.) Gas Cylinder Rules, 1981 (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r.) Workmen's Compensation Act, 1923 (s.) Workmen's Compensation Rules, 1924 (t.) NTPC Safety Rules for Construction and Erection (u.) NTPC Safety Policy (v.) Any other statutory codes / standards / regulations, as may be applicable.			
	Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply: a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute, U.S.A. h) International Organisation for Standardisation (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC)/European Norm (EN) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI)			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 3 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	p) IEEE standard q) JEC standard	
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.	
5.04.00	Not used.	
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.	
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.	
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.	
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.	
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE	
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.	
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2
		GENERAL TECHNICAL REQUIREMENTS
		PAGE 4 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 5 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 6 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 7 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	x) Mass Balance Diagram xi) Characteristic Curves/ Performance Correction Curves. xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure temperature, fluid handled & end connection details, forces, moments etc. xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xiv) Protection system diagrams and relay settings. xv) Cables schedules and interconnection diagrams. xvii) Cable routing plan. xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points. xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. xxiii) Detailed Control system manuals. xxiv) Detailed flow chart for digital control system. xv) Mimic diagram layout, Assignment for other application engg. drawings and documents. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 8 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
8.03.02	scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. xxvii) Underground facilities, levelling, sanitary, land scaping drawings. xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance. The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.			
	INSTRUCTION MANUALS The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 9 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows: 1) <u>Chapter 1 - Plant Description:</u> To contain the following sections specific to the equipment/system supplied a) Description of operating principle of equipment / system with schematic drawing / layouts.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 10 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided. (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 11 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc. (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 12 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.			
8.03.03	After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.			
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT			
8.03.03.01	PLANT HANDBOOK The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 13 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	iv) Sequence & Protection Interlock Schemes. v) Alarm and trip values. vi) Performance Curves. vii) General layout plan and layout of main plant building and auxiliary buildings viii) Important Do's & Don't's The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.			
8.03.03.02	PROJECT COMPLETION REPORT The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
8.03.04	DRAWINGS a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check. ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC. Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site. The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats. iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C. iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 14 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference. Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 15 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 16 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
8.04.00	Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.			
	j)	As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per Annexure VI .		
	k)	Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.		
	l)	The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.		
	m) n)	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. The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.		
	ENGINEERING INFORMATION SUBMISSION SCHEDULE			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 17 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.			
8.05.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.05.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
8.05.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.			
8.06.00	Engineering Co-ordination Procedure			
8.06.01	The following principal coordinators will be identified by respective organizations at time of award of contract: NTPC Engineering Coordinator (NTPC EC): Name :			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 18 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE :			
8.06.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.			
8.06.03	Contractor's/Vendor's Drawing Submission and Approval Procedure: a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering. c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance. d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor,			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 19 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records. h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 20 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
9.00.00	TECHNICAL CO-ORDINATION MEETING			
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.			
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS	PAGE 21 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 22 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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.			
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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 23 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm ² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment,			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 24 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 25 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.			
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.			
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.			
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.			
20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.			
21.00.00	QUALITY ASSURANCE PROGRAMME			
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 26 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 27 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.			
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.			
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 28 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	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. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the 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		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS
			PAGE 30 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following. 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. <u>Elevated Temperature Test Cycle</u> During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 31 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.			
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.			
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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 32 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.			
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC			
23.03.00	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 33 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review. (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release. (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.			
23.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.			
24.00.00	PROJECT MANAGER'S SUPERVISION			
24.01.00	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.			
24.02.00	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 34 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(a.) Interpretation of all the terms and conditions of these documents and specifications (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is 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			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 35 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
25.04.00 25.05.00 25.06.00 25.07.00 25.08.00 25.09.00	(2) copies. 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. 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. 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. 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. 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. 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 36 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
25.10.00	Associated document for Quality Assurance programme			
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.			
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.			
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).			
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.			
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.			
25.11.00	Not Used			
25.12.00	DEMONSTRATION OF APPLICATION ENGINEERING			
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 37 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
25.12.02	e) Calculations (Basic & Performance Calculations). The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings. After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 38 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
26.01.00	(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. Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization 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 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 39 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
26.03.00	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 loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (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 and initial operation shall make the unit ready to conduct such test. Such test will be commenced, within a period of <u>three (3) months</u> after the successful completion of Initial Operations. Any extension of time beyond the above <u>three (3) months</u> shall be mutually agreed upon. 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 withheld 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 two (2) manmonth. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.			
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 (7 man months in case of projects where ZLD system is included in scope) and 3 man months (4 man months in case of projects where ZLD system is included in scope) respectively for O&M and			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 41 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
28.04.00	Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.			
28.05.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.			
28.06.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.			
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
30.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable: a) Ball Mill < 90 dBA			
31.00.00	PACKAGING AND TRANSPORTATION 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			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 42 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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)	
	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	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS
PAGE 43 OF 83				

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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).			
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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 44 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
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 "Technical Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.			
38.01.00	Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.			
39.00.00	MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and 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			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 45 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	connection drawings etc as required to do the testing and maintenance of the electronic modules.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 46 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 47 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)	
	IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965	
	IS:2825	Code for unfired vessels		
	IS:1520	Horizontal centrifugal pumps for clear cold and fresh water		
	IS:1600	Code for practice for performance of constant speed IC Engines for general purpose		
	IS:1601	Specification for performance of constant speed IC Engines for general Purpose		
	IS:1893	Criteria for earthquake resistant design of structures		
	IS1978-1971	Line Pipe April 1969.	API Standards 5L	
	IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954	
	IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968	
	IS:2312	Propellant type Ventilation fans		
	IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 48 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963	
	IS:3354	Outline dimensions for electric lifts.		
	IS:3401	Silica gel		
	IS:3588	Specification for electrical axial flow fans		
	IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)		
	IS:3677	Unbonded rock and slag wool for thermal insulation		
	IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)	
	IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks		
	IS:3963	Roof extractor unit		
	IS:3975	Mild steel wires, strips and tapes for armouring cables		
	IS:4503	Shell and tube type heat Exchanger		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 49 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
IS:4540	Specification for monorail rectifier assembly equipment		
IS:4671	Expanded polystyrene for thermal insulation purpose		
IS:4736	Hot dip zinc coating on steel tubes		
IS:4894	Centrifugal fans		
IS:5456	Code of practice for testing of positive displacement type air compressors and exhausters (For Test Tolerance Only)		
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958	
IS:6392	Steel pipe flanges	BS 4504 : 1969	
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956	
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
IS:7373	Specification for wrought aluminium and aluminium sheet and strips		
IS:7938	Air receivers for compressed air installation		
ISO:1217	Displacement compressor-Acceptance test		
ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling		
ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	PAGE 50 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 51 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 52 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	(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.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS
			PAGE 53 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.		
	IS: 516	Method of test for strength of concrete.		
	IS: 650	Specification for standard sand for testing of cement.		
	IS: 1199	Methods of sampling and analysis of concrete.		
	IS: 1791	General requirements for batch type concrete mixers.		
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).		
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.		
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.		
	IS: 2438	Specification for roller pan mixer.		
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.		
	IS: 2505	General requirements for concrete vibrators, immersion type.		
	IS: 2506	General requirements for concrete vibrators, screed board type.		
	IS: 2514	Specification for concrete vibrating tables.		
	IS: 2645	Specification for Integral cement water proofing compounds.		
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)		
	IS: 2750	Specification for Steel scaffolding.		
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.		
	IS: 3025	Methods of sampling and test waste water.		
	IS: 3366	Specification for Pan vibrators.		
	IS: 3370	Code of practice for concrete structures for the storage of		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 54 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 55 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS: 9417 Recommendations for welding cold worked steel bars for reinforced concrete construction. IS: 10262 Recommended guidelines for concrete mix design. IS: 11384 Code of practice for composite construction in structural steel and concrete. IS: 11504 Criteria for structural design of reinforced concrete natural draught cooling towers. IS: 12118 Specification for two-parts poly sulphide. IS: 12200 Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. IS: 13311 Method of non-destructive testing of concrete. Part-1 Ultrasonic pulse velocity. Part-2 Rebound hammer. SP:23 Handbook of concrete mixes SP: 24 Explanatory Handbook on IS: 456-1978 SP: 34 Handbook on concrete reinforcement and detailing. Precast Concrete Works SP: 7(PartVII/ National Building Code- Structural design of prefabrication and Sec.7) systems building. IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 56 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced). IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils. Fabrication and Erection of Structural Steel Work IS: 2016 Specification for plain washers.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 57 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS: 1608 Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. IS: 1599 Method of Bend Tests for Steel products other than sheet, strip, wire and tube IS : 228 Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. IS : 2595 Code of Practice for Radio graphic testing. IS : 1182 Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. IS : 3664 Code of practice for Ultra sonic Testing by pulse echo method. IS : 3613 Acceptance tests for wire flux combination for submerged Arc Welding. IS : 3658 Code of practice for Liquid penetrant Flaw Detection. IS : 5334 Code of practice for Magnetic Particle Flaw Detection of Welds. Plastering and Allied Works IS : 1635 Code of practice for field slaking of Building lime and preparation of putty. IS : 1661 Application of cement and cement lime plaster finishes. IS : 2333 Plaster-of-paris. IS : 2402 Code of practice for external rendered finishes. IS : 2547 Gypsum building plaster. IS : 3150 Hexagonal wire netting for general purpose. Acid and Alkali Resistant Lining IS : 158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. IS : 412 Specification for expanded metal steel sheets for general purpose.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS : 4441 Code of practice for use of silicate type chemical resistant mortars. IS : 4443 Code of practice for use of resin type chemical resistant mortars. IS : 4456 Method of test for chemical resistant tiles. (Part I & II) IS : 4457 Specification for ceramic unglazed vitreous acid resistant tiles. IS : 4832 Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type IS : 4860 Specification for acid resistant bricks. IS : 9510 Specification for bitumasitc, Acid resisting grade. Water Supply, Drainage and Sanitation IS : 458 Specification for concrete pipes. IS : 554 Dimensions for pipe threads, where pressure tight joints are made on thread. IS : 651 Specification for salt glazed stoneware pipes. IS : 774 Flushing cisterns for water closets and urinals. IS : 775 Cast iron brackets and supports for wash basins and sinks. IS : 778 Copper alloy gate, globe and check valves for water works purposes. IS : 781 Cast copper alloy screw down bib taps and stop valves for water services. IS : 782 Caulking lead. IS : 783 Code of practice for laying of concrete pipes.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 60 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IS : 1172	Basic requirements for water supply, drainage and sanitation.	
	IS : 1230	Cast iron rain water pipes and fittings.	
	IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.	
	IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.	
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.	
	IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.	
	IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.	
	IS : 1726	Cast iron manhole covers and frames.	
	IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.	
	IS : 1742	Code of practice for building drainage.	
	IS : 1795	Pillar taps for water supply purposes.	
	IS : 1879	Malleable cast iron pipe fittings.	
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.	
	IS : 2065	Code of practice for water supply in building.	
	IS : 2326	Automatic flushing cisterns for urinals.	
	IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.	
	IS : 2501	Copper tubes for general engineering purposes.	
	IS : 2548	Plastic seat and cover for water-closets.	
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).	
	IS : 2963	Non-ferrous waste fittings for wash basins and sinks.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS
			PAGE 61 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	IS : 3114	Code of practice for laying of cast iron pipes.	
	IS : 3311	Waste plug and its accessories for sinks and wash basins.	
	IS : 3438	Silvered glass mirrors for general purposes.	
	IS : 3486	Cast iron spigot and socket drain pipes.	
	IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).	
	IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.	
	IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.	
	IS : 4127	Code of practice for laying of glazed stone-ware pipes.	
	IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.	
	IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.	
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.	
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.	
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.	
	IS : 5961	Cast iron grating for drainage purpose.	
	IS : 7740	Code of practice for road gullies.	
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.	
	IS : 8934	Cast copper alloy fancy pillar taps for water services.	
	IS : 9762	Polyethylene floats for ball valves.	
	IS : 10446	Glossary of terms for water supply and sanitation.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS
			PAGE 62 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 63 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS:2209 Mortice locks (vertical type). IS:2553 Safety glass IS:2835 Flat transparent sheet glass. IS:3548 Code of practice for glazing in buildings. IS:3564 Door closers (Hydraulically regulated). IS : 3614 Fire check doors; plate, metal covered and rolling type. IS:4351 Steel door frames. IS:5187 Flush bolts. IS:5437 Wired and figured glass IS:6248 Metal rolling shutters and rolling grills. IS:6315 Floor springs (hydraulically regulated) for heavy doors. IS:7196 Hold fasts. IS:7452 Hot rolled steel sections for doors, windows and ventilators. IS:10019 Mild steel stays and fasteners. IS:10451 Steel sliding shutters (top hung type). IS:10521 Collapsible gates. R oof Water Proofing and Allied Works IS:1203 Methods of testing tar and bitumen. IS:1322 Specification for bitumen felts for water proofing and damp proofing. IS:1346 Code of practice for water proofing of roofs with bitumen felts. IS:1580 Specification for bituminous compound for water proofing and caulking purposes.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 64 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS:3384 Specification for bitumen primer for use in water proofing and damp proofing. Floor Finishes and Allied Works IS:1237 Specification for cement concrete flooring tiles. IS:1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS:2114 Code of practice for laying in-situ terrazzo floor finish. IS:2571 Code of practice for laying in-situ cement concrete flooring. IS:3462 Specification for unbacked flexible PVC flooring. IS:4971 Recommendations for selection of industrial floor finishes. IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS:8042 Specification for white portland cement. IS:13801 Specification for chequered cement concrete flooring tiles. Painting and Allied Works IS:162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required. IS:1477 Code of practice for painting of ferrous metals in buildings. Part-I Pretreatment. Part-II Painting. IS:1650 Specification for colours for building and decorative finishes. IS:2074 Specification for red oxide-zinc chrome, priming, ready mixed paint air drying. IS:2338 Code of practice for finishing of wood and wood based materials. Part-I Operations and workmanship			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS PAGE 65 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	Part-II	Schedules	
	IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.	
	Part-I	Operations and workmanship.	
	Part-II	Schedule.	
	IS:2524	Code of practice for painting of nonferrous metals in buildings.	
	Part-I	Pretreatment.	
	Part-II	Painting.	
	IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.	
	IS:2933	Specification enamel paint, under coating and finishing.	
	IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.	
	IS:5410	Specification for cement paint	
	IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use	
	IS:6278	Code of practices for white washing and colour washing.	
	IS:10403	Glossary of terms relating to building finishes.	
	Piling and Foundation		
	IS:1080	Code of practice for design and construction of simple spread foundations.	
	IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.	
	IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).	
	IS:2950	Code of practice for designs and construction of Raft (Part-I) foundation.	
	IS:2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.	
	IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS
			PAGE 66 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:8009 Part-I Part-II IS:12070 DIN:4024 VDI:2056 VDI:2060 Stop Log and Trash Rack IS:4622 IS:5620 IS:11388 IS:11855 Roads IRC:5 IRC:14 IRC:16 IRC:19 IRC:21 IRC:34 IRC:36 IRC:37 IRC:56 IRC:73 IRC:86	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Shallow foundations. Deep foundations. Code of practice for design and construction of shallow foundations on rocks. Flexible supporting structures for machines with rotating machines. Criteria for assessing mechanical vibrations of machines. Criteria for assessing rotating imbalances in machines. Recommendations for fixed - wheel gates structural design. Recommendations for structural design criteria for low head slide gates. Recommendations for design of trash rack for intakes. General requirements for rubber seals for hydraulic gates. Standard specifications and Code of practice for road bridges, section-I general Features of Design. Recommended practice of 2cm thick bitumen and tar carpets. Specification for priming of base course with bituminous primers. Standard specifications and code of practice for water bound macadam. Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). Recommendations for road construction in waterlogged areas. Recommended practice for the construction of earth embankments for road works. Guidelines for the Design of flexible pavements. Recommended practice for treatment of embankment slopes for erosion control. Geometric design standards for rural (non-urban) highways. Geometric Design standards for urban roads in plains.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 67 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IRC:SP:13 Guidelines for the design of small bridges & culverts. IRC - Public- Ministry of Surface Transport (Roads Wing), Specifications ation for road and bridge works. IS:73 Specification for paving bitumen Loadings IS:875 Code of practice for design loads other than earthquake) for (Pt. I to V) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of Practice for design and construction of foundation for transmission line towers & poles. IRC:6 Standard specifications & code of practice for road bridges, Section-II Loads and stresses. M.O.T. Deptt. of railways Bridge Rules. Safety IS:3696 Safety code for scaffolds and ladders. (Part I & II) IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings)			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 68 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria 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 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 69 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973); IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968). - 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. - Printed circuit boards - IPC TM - 650, IEC 326 C. - General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. - Edge socket connectors - IEC 130-11. - Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. - Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). - Direct acting electrical indicating instrument - IS:1248 - 1968 (R). - Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. - Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. - Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. - Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 70 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	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. 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 71 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTM 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. 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 72 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 73 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 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 staiton (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.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 74 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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 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-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 75 OF 83

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN	
	ITEM : SUB-SYSTEM:		PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:	
			QP NO.: REV.NO.: DATE: 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				M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	**	10.	11.	

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC
 P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'

MANUFACTURER/ SUB-SUPPLIER		SIGNATURE	FOR NTPC USE	DOC. NO.:	REV..... CAT.....
	MAIN-SUPPLIER				
	APPROVED BY				

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

1/1

ENGG. DIV./QA&I

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT
		PAGE 76 OF 83

ANNEXURE-III

		Project :		Stage :		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL						DOC. NO.:	
		Package Supplier :										REV. NO.:	
		Contractor No. :										DATE :	
						SUB-SYSTEM :						PAGE : OF	
S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details on schedule	Remarks			

LEGENDS

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

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

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

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

QP/INSPN CATEGORY:

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

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

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

FORMAT NO.: QS-01-QAIP-1/F3-R0

1/1

Engg. Div. / QA&I

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	LOT-1A PROJECTS	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 83
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)																																																																										
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of ROMs/DVDs/Portable Hard Disk</th><th>CD</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td><td></td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td><td></td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td><td></td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td><td></td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td><td></td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td><td></td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">-</td><td rowspan="2"></td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr><tr><td rowspan="2">4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2"></td></tr><tr><td>i) First Submission</td></tr><tr><td rowspan="2">5</td><td>Commissioning and Performance Test Procedure manual</td><td rowspan="2">1 set</td><td rowspan="2">-</td><td rowspan="2"></td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr></table>	S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents				First submission and submission with major changes				▪ Layout (A0&A1 sizes)	4	-		▪ Other Drawings/Documents (A0&A1 sizes)	2	-		▪ P&ID (All sizes)	4	-		a) Final drawings/documents (Directly to site)	6	2		b) "As Built" Drawing/Documents (Directly to site)	6	2		c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2		2	Erection Manual (Directly to site)	4 sets	2		3	Operation & Maintenance manual	1 set	-		i) First Submission		ii) Final Submission (Directly to site)	4 sets	2		4	Plant Hand Book	1	1		i) First Submission	5	Commissioning and Performance Test Procedure manual	1 set	-		i) First Submission		ii) Final Submission (Directly to site)	4 sets	2				
S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD																																																																							
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LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 81 OF 83																																																																							

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																														
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3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C-3

REV. 00

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

3X660 MW NABINAGAR-I FGD

TECHNICAL SPECIFICATION

GYPSUM DEWATERING SYSTEM (ELECTRICAL PORTION)



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



TITLE:

**ELECTRICAL EQUIPMENT SPECIFICATION
FOR****GYPSUM DEWATERING SYSTEM****3X660 MW NABINAGAR-I FGD**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION: **I**REV NO. : **00** DATE: 22.01.2020

SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
I	SPECIFIC TECHNICAL REQUIREMENTS	3
I	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEURE-I)	2
I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
I	TECHNICAL SPECIFICATION FOR MOTORS	10
I	MOTOR DATASHEET-A	1
I	MOTOR DATASHEET-C	2
II	STANDARD SPECIFICATION FOR LV MOTORS	5
II	REFERENCE QUALITY PLAN	3
II	TECHNICAL SPECIFICATION FOR CABLE TRAYS & ACCESSORIES	7
II	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	2

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.



TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
GYPSUM DEWATERING SYSTEM
3X660 MW NABINAGAR-I FGD**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION : **I**
REV NO. : **00** DATE : **22.01.2020**
SHEET : 1 OF 3

**TECHNICAL SPECIFICATION
FOR
GYPSUM DEWATERING SYSTEM
(ELECTRICAL PORTION)**

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR GYPSUM DEWATERING SYSTEM 3X660 MW NABINAGAR-I FGD	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION : I
		REV NO. : 00 DATE : 22.01.2020
		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 SYSTEM (all AC & DC loads at different voltage levels like 415V AC, 240 V AC, 220 V DC etc).
- 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 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.



TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
GYPSUM DEWATERING SYSTEM

3X660 MW NABINAGAR-I FGD**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION : **I**
REV NO. : **00** DATE : **22.01.2020**
SHEET : 3 OF 3

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: GYPSUM DEWATERING SYSTEM

SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT

PROJECT: 3X660 MW NABINAGAR –I FGD

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	11 kV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	HT motor (If applicable), (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 SYSTEM

SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT

PROJECT: 3X660 MW NABINAGAR –I FGD

	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) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
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.

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

SUB-SECTION-II-E2

MOTORS

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

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	MOTORS		
1.00.00	GENERAL REQUIREMENTS		
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.		
1.02.00	All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.		
1.03.00	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		
2.00.00	CODES 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		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 154 of 522	SUB SECTION-II-E2 MOTORS
			PAGE 1 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
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 full load torque.		
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load 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 (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)		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 156 of 522	SUB SECTION-II-E2 MOTORS
			PAGE 3 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	
7.03.00	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 & 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 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 with adjustable alarm contact and preferably 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 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be 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.	
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 157 of 522
SUB SECTION-II-E2 MOTORS		PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS		
7.11.00	The spacing between gland plate & centre of 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, 3.3 kV /415V systems without any injurious effect on its life.		
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.		
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.		
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5		
10.00.00	TYPE TEST		
10.01.00	HT MOTORS		
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.		
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different 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		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 158 of 522	SUB SECTION-II-E2 MOTORS
			PAGE 5 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.01.04	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. 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.			
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.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 159 of 522	SUB SECTION-II-E2 MOTORS	PAGE 6 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	(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 50 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 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)		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 160 of 522	SUB SECTION-II-E2 MOTORS
			PAGE 7 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	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.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 161 of 522	SUB SECTION-II-E2 MOTORS	PAGE 8 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																																																									
	TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><tr><td>Motor MCR in KW of</td><td colspan="3">Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.</td></tr><tr><td>UP to 3 KW</td><td colspan="3"></td></tr><tr><td>Above 3 KW - upto 7 KW</td><td colspan="3">85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td colspan="3">115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td colspan="3">167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td colspan="3">196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td colspan="3">249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td colspan="3">277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td colspan="3">331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td colspan="3">203</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><td>Motor MCR in KW</td><td colspan="3">Clearance</td></tr><tr><td>UP to 110 KW</td><td colspan="3">10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td colspan="3">12.5mm</td></tr><tr><td>Above 150 KW</td><td colspan="3">19mm</td></tr></table>				Motor MCR in KW of	Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.			UP to 3 KW				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	203			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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LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1)-2 Page 162 of 522	SUB SECTION-II-E2 MOTORS	PAGE 9 OF 9																																																								

	TITLE LV MOTORS <u>DATA SHEET-A</u> 3X660 MW NABINAGAR-I FGD	SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
		REV. NO.	DATE-22.01.2020
		SHEET 1	OF 2

ANNEXURE-III

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	200KW *
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
	o Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Winding & Insulation	:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data	:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)	:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.2 kW
11.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box	:	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		

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

Page 163 of 522

	TITLE MOTORS DATA SHEET – C 3X660 MW NABINAGAR-I FGD	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 22.01.2020
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTORS DATA SHEET – C 3X660 MW NABINAGAR-I FGD	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 22.01.2020
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.		
3.3.3 The following frequency of starts shall apply		
i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.		
ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)		
iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor		
3.4 Running Requirements		
3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.		
3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.		
3.5 Stress During bus Transfer		
3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.		
3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.		
3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.		
3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.		
4.0 CONSTRUCTIONAL FEATURES		
4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy		
4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.		
Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled		
4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

SUB-SECTION-V-QE1

MOTORS

MOTOR

[illegible]

CLAUSE NO.		QUALITY ASSURANCE																	
Wound stator		Y	Y					Y	Y										
Wound Exciter		Y	Y					Y	Y										
Rotor complete		Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly		Y	Y					Y											
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.		Y	Y	Y															
Complete Motor		Y	Y	Y											Y	Y	Y	Y1	Y
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. 4. Y1 = for HT Motor / Machines only.																			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE					TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2					SUB-SECTION-V-QE1 MOTORS					PAGE 2 OF 2				

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.02.00	Support System for Cable Trays			
3.02.01	Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.			
3.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder - Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. - The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised. - The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied - All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. - The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079. - Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position. - Support system shall be able to withstand - weight of the cable trays - weight of the cables (75 Kg/Metre run of each cable tray) - Concentrated load of 75 Kg between every support span. - Factor of safety of minimum 1.5 shall be considered.			
3.02.03	The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to			
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 4 of 69

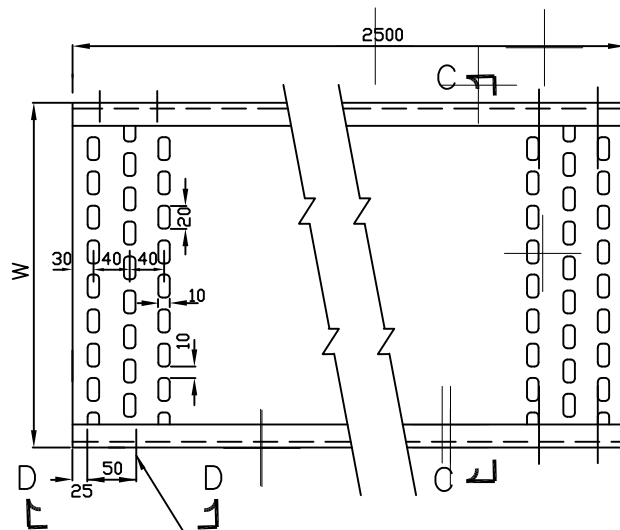
CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.02.04 3.02.05 3.03.00 3.03.01 3.03.02 3.03.03 3.03.04 3.03.05 3.03.06 3.04.00 3.04.01	the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid. Four legged structure shall be provided wherever there is change in elevation and change in direction FOR COAL HANDLING PLANT/FGD PLANT AREA THE FOLLOWING SHALL ALSO BE APPLICABLE: a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route. b) Cable trenches shall be provided only in Switchgear/MCC rooms. c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc. d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits. Pipes, Fittings & Accessories Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria GI Pipes shall be of medium duty as per IS: 1239 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes. Hume pipes shall be NP3 type as per IS 458. TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I. Junction Boxes Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of	
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION Page 5 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:- (a) Impact resistance for impact energy of 2 Joules (IK07) as per BS EN50102 (b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb. (c) Class of protection shall be IP 55. (d) HV test. 3.04.02 Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire. 3.05.00 Terminations & Straight Through Joints 3.05.01 Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE -A-51-RA of cable lug attached at the end of this chapter). 3.05.02 Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec with dynamic peak of 52 KA for 33 KV system & of 40 KA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design 3.05.03 1.1 KV grade Straight Through Joint shall be of proven design.			
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 6 of 69	

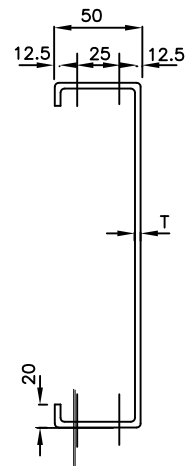
CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.06.00	Cable glands	
3.06.01	Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) 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.	
3.07.00	Cable lugs/ferrules	
3.07.01	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 IS/DIN standards.	
3.08.00	Trefoil clamps	
3.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.	
3.09.00	Cable Clamps & Ties	
3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyester coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.	
3.10.00	Receptacles	
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity ranging from 30-300 mA	
3.11.00	Cable Drum Lifting Jack	
	The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for	
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION
		Page 7 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.		
3.12.00	Galvanising		
3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.		
3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified		
3.13.00	Welding		
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595		
4.00.00	INSTALLATION		
4.01.00	Cable tray and Support System Installation		
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.		
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.		
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.		
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.		
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.		
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION
			Page 8 of 69

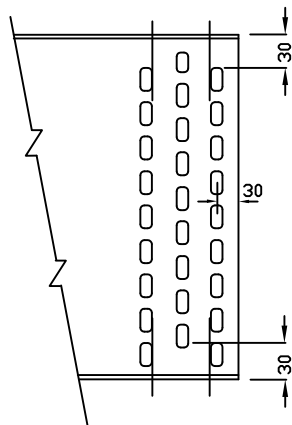
CLAUSE NO.	TECHNICAL REQUIREMENTS											
	prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.											
4.02.00	Conduits/Pipes/Ducts Installation											
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.											
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.											
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material											
4.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise <table><tr><th>Conduit /pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm and above</td><td>3.0 M</td></tr></table>	Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M	
Conduit /pipe size (dia).	Spacing											
Upto 40 mm	1 M											
50 mm	2.0 M											
65-85 mm	2.5 M											
100 mm and above	3.0 M											
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.											
4.03.00	Junction Boxes Installation											
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.											
4.04.00	Cable Installation											
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.											
4.04.02	For Cable unloading, pulling etc following guidelines shall be followed in general: a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.											
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION Page 9 of 69										



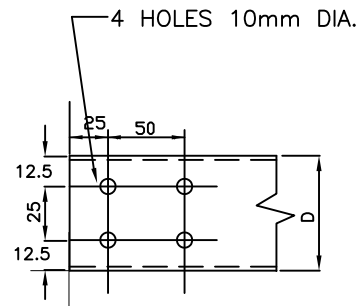
4 HOLES 10mm DIA.



SECTION-CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS



VIEW-DD
(100,50W TRAYS)

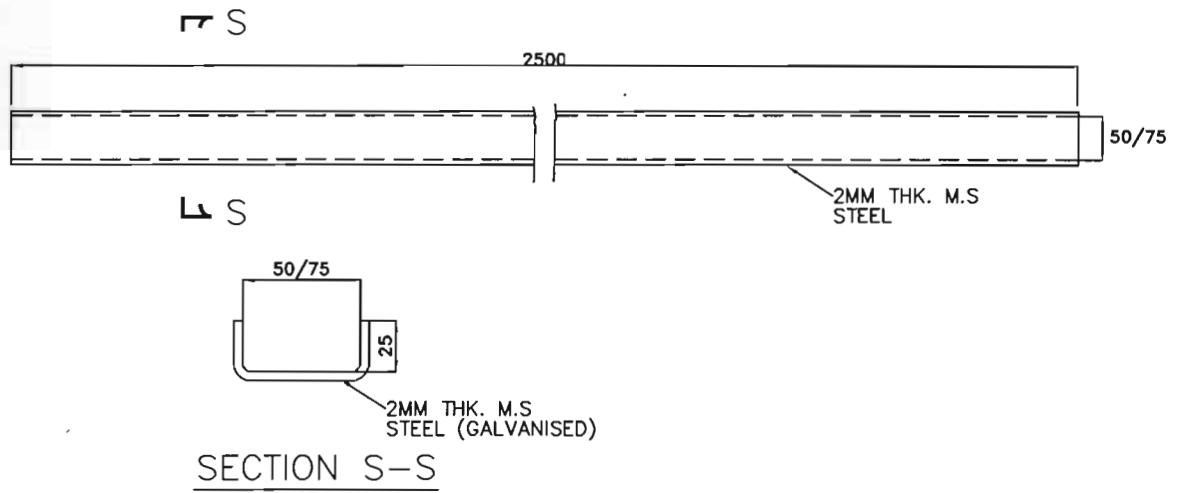
TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES

DWG. NO.



CABLE TROUGHS

SEE GENERAL NOTES IN SHEET 11.



TYPICAL DETAILS OF CABLE TRAY AND ACCESSORIES

BHEL DRAWING NO.
PE-DG-427-507-E005

SH 10 OF 11

REV 00



3x660 MW NABINAGAR STPP
GYP SUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
(C&I PORTION)

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : C-4

REV. 00

SECTION: I

SUB-SECTION: C-4

TECHNICAL SPECIFICATION (C&I PORTION)

	3X660 MW NPGCPL NABINAGAR - FGD	SECTION: C
	TECHNICAL REQUIREMENTS (C&I) GYPSUM DEWATERING SYSTEM	

CONTROL AND INSTRUMENTATION FOR GYPSUM DEWATERING SYSTEM

				
	3X660 MW NPGCPL NABINAGAR - FGD		DESG	SB/KKM <i>Sandip</i>
	JOB NO: 457		CHKD	KKM <i>KKM</i>
	REV. NO. 00	DATE: 01.02.2020	APPD	RKR <i>RKR</i>



C&I SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

SECTION: C
SUB SECTION: C&I

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENT
4	GENERAL TECHNICAL REQUIREMENTS
5	LIST OF DOCUMENTS/DELIVERABLES
6	SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY), VFD, ELECTRICAL ACTUATOR AND LCP
7	INSTRUMENTATION CABLE, CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
8	INSTRUMENT STUB DETAILS
9	INSTRUMENT INSTALLATION DRAWING
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
14	SUB VENDOR LIST



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

SECTION: C
SUB SECTION: C&I

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

|



C&I SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

SECTION: C
SUB SECTION: C&I

Specific Technical Requirements (C&I):

1. GYPSUM DEWATERING SYSTEM (GDS) 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 SYSTEM

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 SYSTEM

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 SYSTEM

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.



C&I SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

SECTION: C
SUB SECTION: C&I

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 SYSTEM**

SECTION: C
SUB SECTION: C&I

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



**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 SYSTEM**

SECTION: C
SUB SECTION: C&I

LIST OF DOCUMENTS/DELIVERABLES

|



C&I SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

SECTION: C
SUB SECTION: C&I

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT

Sl. No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V4-457-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V4-457-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V4-457-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V4-457-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V4-457-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V4-457-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V4-457-145-I907	FIELD JB/LIE/LIR, DRIVES TERMINATIONS	A
8	PE-V4-457-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V4-457-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V4-457-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V4-457-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V4-457-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V4-457-145-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 SYSTEM**

SECTION: C
SUB SECTION: C&I

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

CLAUSE NO.	TECHNICAL REQUIREMENTS	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.			
LOT-IA PROJECTS 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			एनटीपीसी NTPC						
16.00.00	FIELD INSTRUMENTS BASED ON FIELDBUS The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.									
16.01.00	Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements. <table><tr><th>S No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>FOUNDATION Fieldbus/PROFIBUS PA based output</td></tr></table>				S No.	Features	Essential/Minimum Requirements	1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output
S No.	Features	Essential/Minimum Requirements								
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output								
LOT-1A PROJECTS, 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 5 OF 8						

CLAUSE NO.		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
		2	Accuracy	± 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.	
		3.	Stability	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.	
		4	Turn down	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).	
		5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	
		6.	Electrical connection	½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible	
		7.	Process connection	½” NPT (F)	
		8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.	
			Overpressure	150% of max operating pressure	
		9	Accessories	-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.	
LOT-1A PROJECTS, 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		एनटीपीसी NTPC																					
	10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.																					
	11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter																					
	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.
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.																						
LOT-1A PROJECTS, 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.	एनटीपीसी NTPC 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 =<0.25% of 0-250 deg C span T/C-K type =<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.		
LOT-1A PROJECTS, 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.		
LOT-1A PROJECTS 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 3 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
2.03.00	Adjustment/ calibration	Using hand held HART calibrator/ centralized PC based system (as applicable).		
	Zero & span adjustment	Continuous, temper 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.		
	Display	Integral digital display.		
	Load Impedance	500 ohms (minimum).		
	Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 50081-2 & EN 50082-2		
	Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.		
	Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.			
Ultrasonic Type level Transmitter				
S.No.	Features	Essential/Minimum requirement		
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.		
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).		
LOT-1A PROJECTS 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 4 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
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		
LOT-1A PROJECTS 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		एनटीपीसी NTPC												
2.04.00	16.	Accessories	- All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. - All mounting accessories required for erection and commissioning shall be provided. - For hazardous area, explosion proof enclosure as described in NEC article 500												
	Note: 1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level. 2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer’s approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC. 3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.														
	Specification for ULTRASONIC TYPE FLOW TRANSMITTER <table><tr><th>S.No</th><th>Features</th><th>Essential/Minimum requirement</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type.</td></tr><tr><td>2.</td><td>Output signal</td><td>4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).</td></tr><tr><td>3.</td><td>Sensor Accuracy</td><td>+/- 2% of calibrated span.</td></tr></table>			S.No	Features	Essential/Minimum requirement	1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type.	2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).	3.	Sensor Accuracy	+/- 2% of calibrated span.
	S.No	Features	Essential/Minimum requirement												
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type.													
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).													
3.	Sensor Accuracy	+/- 2% of calibrated span.													
LOT-1A PROJECTS 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 6 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

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
3.02.00	Resistance Temperature Detector (RTD)			
	Sr. No.	Features	Essential/Minimum Requirements	
	1	Type of RTD.	: Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).	
	2	No. of element	: Duplex	
	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well	
	4	Insulation and sheathing of RTD	: Mineral (magnesium oxide) insulation and SS316 sheath,	
	5	Calibration and accuracy	: As per IEC-751/ DIN-43760 Class-A for RTD	
	6	Accessories	: Thermo well and associated fittings	
	7	Standard	: IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.	
	NOTES :			
	1)	The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.		
	2)	The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.		
	3.03.00	Metal Temperature Thermocouples		
		Measuring Medium	Metal Temperature	
Material of Thermocouple.		Chromel Alumel Type K		
Type of Thermocouple		Duplex with ungrounded separate hot junctions		
Insulation		Mineral Insulation (Magnesium Oxide).		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 9 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00	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.			
3.04.00	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.		
LOT-1A PROJECTS 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 10 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC																																											
4.00.00	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE. <table border="1" data-bbox="338 936 1457 1892"> <tr> <th data-bbox="338 936 416 1025">Sl. No</th><th data-bbox="416 936 616 1025">FEATURES</th><th colspan="3" data-bbox="616 936 1457 1025">ESSENTIAL/MINIMUM REQUIREMENTS</th></tr> <tr> <td data-bbox="338 1025 416 1151"></td><td data-bbox="416 1025 616 1151"></td><td data-bbox="616 1025 868 1151">Pr. Gauge/ DP Gauge/ Draught gauges</td><td data-bbox="868 1025 1120 1151">Temperature Gauge</td><td data-bbox="1120 1025 1457 1151">Level Gauge</td></tr> <tr> <td data-bbox="338 1151 416 1357">1</td><td data-bbox="416 1151 616 1357">Sensing Element</td><td data-bbox="616 1151 868 1357">Bourdon for high pressure, Diaphragm/ Bellow for low pr.</td><td data-bbox="868 1151 1120 1357">Inert gas actuated/ Liquid filled other than mercury</td><td data-bbox="1120 1151 1457 1357">Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.</td></tr> <tr> <td data-bbox="338 1357 416 1482">2</td><td data-bbox="416 1357 616 1482">Material of sensing element</td><td data-bbox="616 1357 868 1482">SS 316</td><td data-bbox="868 1357 1120 1482">SS 316</td><td data-bbox="1120 1357 1457 1482"></td></tr> <tr> <td data-bbox="338 1482 416 1581">3</td><td data-bbox="416 1482 616 1581">Material of movement</td><td data-bbox="616 1482 868 1581">SS 304</td><td data-bbox="868 1482 1120 1581">SS 304</td><td data-bbox="1120 1482 1457 1581"></td></tr> <tr> <td data-bbox="338 1581 416 1671">4</td><td data-bbox="416 1581 616 1671">Body material</td><td data-bbox="616 1581 868 1671">Die-cast aluminium</td><td data-bbox="868 1581 1120 1671">Die-cast aluminium</td><td data-bbox="1120 1581 1457 1671">Forged carbon steel/304 SS</td></tr> <tr> <td data-bbox="338 1671 416 1767">5</td><td data-bbox="416 1671 616 1767">Dial size</td><td data-bbox="616 1671 868 1767">150mm</td><td data-bbox="868 1671 1120 1767">150 mm</td><td data-bbox="1120 1671 1457 1767">Tubular covering entire range</td></tr> <tr> <td data-bbox="338 1767 416 1892">6</td><td data-bbox="416 1767 616 1892">End connection</td><td data-bbox="616 1767 868 1892">1/2 inch NPT (M)</td><td data-bbox="868 1767 1120 1892">1/2 inch or 3/4 inch NPT (M).</td><td data-bbox="1120 1767 1457 1892">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
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LOT-1A PROJECTS 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				एनटीपीसी NTPC
	7	Accuracy	±1% of span	± 1% of span	± 2%
	8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
	9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
	10	Over range	125% of FSD	125% of FSD	-
	11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
	12	Zero/span adjustment	Provided	Provided	--
	13	Identification	Engraved with service legend or laminated phenolic name plate		
	14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
	Notes:-				
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
LOT-1A PROJECTS 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 एनटीपीसी NTPC			
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	-
LOT-1A PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	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.		
LOT-1A PROJECTS 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			

CLAUSE NO.	TECHNICAL REQUIREMENTS	
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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)	
LOT-1A PROJECTS 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 16 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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.

LOT-IA PROJECTS 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			एनटीपीसी NTPC																					
9.04.00																									
	ROTAMETERS																								
	<table><tr><th>Sr. No.</th><th>Features</th><th colspan="2">Essential / minimum requirements</th></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	
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LOT-1A PROJECTS 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 18 OF 34																									

CLAUSE NO.	एनटीपीसी 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 transmission Signal	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.	
LOT-1A PROJECTS 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	SO2:- 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	
LOT-IA PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS	

10.04.00

pH Analyser		
a)	Type	: Cell - flow through
b)	Accuracy	: < ± 1% of reading
c)	Range	: 0 - 14 pH freely programmable (For others)
d)	No. of steams	: Single
e)	Temp. compensation	: Automatic

LOT-IA PROJECTS 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 22 OF 34
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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

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																	
	<table><tr><td>1. Type</td><td colspan="2">Continuous flow through type</td></tr><tr><td>2. Range</td><td colspan="2">0 - 14 pH freely programmable</td></tr><tr><td>3. Accuracy</td><td colspan="2">< ± 1% of reading</td></tr><tr><td>4. Temperature Compensation</td><td colspan="2">Automatic</td></tr><tr><td>5. No. of Streams</td><td colspan="2">Single</td></tr></table>			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	
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	5. No. of Streams	Single																
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CLAUSE NO.	TECHNICAL REQUIREMENTS	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: <table><tr><td>(a) Output :</td><td>4-20 mA DC Isolated output</td></tr><tr><td>(b) Accuracy :</td><td>± 0.5% of calibrated span or better *</td></tr><tr><td>(c) Repeatability :</td><td>± 0.2% of calibrated span or better</td></tr><tr><td>(d) Ambient Temp. & : Humidity</td><td>4 deg.C to 55 deg.C. 5% to 100% RH</td></tr><tr><td>(e) Power Supply :</td><td>240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor.</td></tr><tr><td>(f) Protection class :</td><td>IP-55</td></tr><tr><td>(g) Flow tube</td><td>SS304</td></tr><tr><td>(h) liner</td><td>Hard Rubber</td></tr></table> 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.	(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		
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LOT-1A PROJECTS 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.			
LOT-1A PROJECTS, 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	PAGE 1 OF 4

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.			
LOT-1A PROJECTS, 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	PAGE 2 OF 4

CLAUSE NO.	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.			
LOT-1A PROJECTS, 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	PAGE 3 OF 4

CLAUSE NO.	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.

LOT-1A PROJECTS, 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	एनटीपीसी NTPC		
	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.			
LOT-IA PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
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.			
LOT-IA PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
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			
	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
LOT-IA PROJECTS 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			
LOT-IA PROJECTS 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 4 OF 5	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
8.00.00			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.	
	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.					
LOT-IA PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.00.00	CODES AND STANDARDS DC Reactor IEC: 60289 Motor IS: 4722/IS: 325/IEC: 60034/NEMA 30 & 31 Transformer IEC: 60076/IS: 2026, IEC: 61378 Dry transformer IS: 11171 VFD IEC: 60034/ IEC: 61800 Harmonics & EM compatibility IEEE: 519/IEC: 61000 Contactor/Switches/Fuses etc. IEC: 60947, IS: 13947	
2.00.00	OPERATING CONDITIONS 2.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. 2.02.00 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. 2.03.00 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. 2.04.00 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 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 and upto 1500 KW : Medium Voltage, Three Phase AC Note: The voltage level mentioned above is the Nominal Voltage which is fed to the motor from the VFD. 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. 2.05.00 For Power Cables & Control Cables, please refer technical specification given elsewhere in the document.	

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC
3.00.00	SYSTEM DESCRIPTION
3.01.00	The VFD System shall include the following equipment for each drive. - Power/control panels consisting of line converters, inverters and control system for drive including complete control & protection of drive and the motor. - VFD transformer on the source side, as per system requirement. - Breaker/Contactor on the VFD/Motor/Transformer/CT/PT/Meters/Bypass (if applicable) side with complete Control, Protection and Diagnostics features of the VFD, as per system requirement. - Bypass Arrangement of the VFD system if specified. - DC air core reactor or capacitor, as per the system requirement. - Inverter Duty Motor suitable for VFD application - Power & control cables and cabling as required under the scope of supply in the technical specifications.
4.00.00	GENERAL REQUIREMENTS
4.01.00	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 shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design.
4.02.00	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.
4.03.00	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.
4.04.00	The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered.
4.05.00	The VFD model offered shall be from the existing VFD model series in the regular manufacturing range of the manufacturer. Along with the offer the Vendor shall submit the supply record and satisfactory performance record for 2 (two) years running of the offered VFD supplied in India or abroad.
4.06.00	The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the Employer's system. All the Motors which are to be driven by VFDs will be of Inverter duty type. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & employer's system.
4.07.00	Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least for 15 years from the date of supply. After this period, if vendor

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	discontinues the production of spare parts, vendor shall give at least twelve (12) months' notice prior to such discontinuation so that owner may order his requirements of spares in one lot. The offered VFD manufacturer should have their maintenance service & spares supply network in India to provide quick maintenance service & Spares supply support. The vendor shall indicate the source for supply of spares & Maintenance service location in India.	
5.00.00	TECHNICAL AND OPERATIONAL REQUIREMENTS	
5.01.00	The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with maximum input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment.	
5.02.00	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.	
5.03.00	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	
5.04.00	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.	
5.05.00	The compliance shall be verified by the contractor by Harmonic studies conducted with maximum and minimum fault level, cable capacitance, system equipment reactance etc. Finally, the compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.	
5.06.00	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.	
5.07.00	The system shall be suitable to maintain speed variation within range 10-110% with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.	
5.08.00	The VFD System shall maintain a power factor of 0.95 (minimum) from 25 % to 100 % of rated speed.	
5.09.00	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.	
6.00.00	VFD COMPATIBILITY WITH THE MOTOR	
6.01.00	For MV VFD Drives, to ensure that there are no problems with motor heating, VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads,	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	with a total harmonic current and voltage distortion within acceptable/standard limits. VFD utilizing output transformers are not acceptable.	
6.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.	
6.03.00	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.	
7.00.00	BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)	
7.01.00	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.	
7.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.	
8.00.00	STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)	
8.01.00	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.	
9.00.00	EFFICIENCY	
9.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for both MV and LV 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.	
9.02.00	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.	
10.00.00	COOLING SYSTEM	
10.01.00	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95%.	
10.02.00	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.	
10.03.00	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 Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.	
10.04.00	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	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.	
11.00.00	VFD TRANSFORMER:	
11.01.00	Type: Out door, Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.	
11.02.00	Transformer shall be suitable for operation with non-sinusoidal wave shape and DC components under normal and abnormal conditions of the system without exceeding the temperature.	
11.03.00	Suitable Design Margin as per applicable standards shall be taken for purpose of sizing of the transformer.	
11.04.00	All other components, technical parameters shall be as per applicable IEC/IS.	
12.00.00	POWER CONVERTER:	
12.01.00	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.	
12.02.00	The converter shall be co-ordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.	
12.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.	
12.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.	
12.05.00	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.	
12.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.	
12.07.00	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.	
12.08.00	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.	
13.00.00	OUTPUT FILTER (AS APPLICABLE):	
13.01.00	Output/ du/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.	
14.00.00	DC LINK CAPACITOR (AS APPLICABLE):	
14.01.00	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	

CLAUSE NO.	TECHNICAL REQUIREMENTS 
15.00.00	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. ENCLOSURE
15.01.00	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.
15.02.00	The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.
15.03.00	All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IS/IEC 60947.
15.04.00	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.
15.05.00	Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.
16.00.00	PAINTING Paint shade shall be as follows a) VFD transformer : RAL 9002 (Grey), legend in black letter b) Motors : RAL 5012 (Blue) c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012) d) VFD reactor enclosure : RAL 5012 (Blue), legend in black letter
17.00.00	BREAKER/CONTACTOR
17.01.00	Type: Shall be SF6 or Vacuum type or air-break restrike free, stored energy operated and with electrical anti-pumping features.
17.02.00	These shall be electrically operated, mechanically latched type & shall have protection against over load, all AC/DC transients and voltage surges etc. Electronic control module shall be electrically isolated.
17.03.00	All other components, technical parameters shall be as per applicable IEC/IS.
18.00.00	MOTORS
18.01.00	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.
18.02.00	Motors shall also meet the requirements mentioned in subsection for motors and relevant IS/IEC.

CLAUSE NO.	TECHNICAL REQUIREMENTS	
18.03.00	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.	
18.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the V _{peak} and dv/dt limits as per IEC-61800.	
18.05.00	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.	
19.00.00	CABLES & CABLING	
19.01.00	All the power cable for the VFD System shall have sufficient current capacity and shall be suitably sized to meet the load demand on the motor.	
19.02.00	VFD Manufacturer shall submit cable sizing & selection criteria of drive cables including grounding/ earthing philosophy to address all the key issues such as EM Noise emissions, Common mode noise, voltage reflections, stray capacitances etc., for owner's review and approval.	
19.03.00	Cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. The instrumentation and other control cables susceptible to interference shall be routed separately from the Power Cables.	
19.04.00	For other control/instrumentation Cables and other components, technical parameters shall be as per applicable IEC/IS/Mentioned Elsewhere in the specifications.	
20.00.00	CONTROL AND PERFORMANCE REQUIREMENTS	
20.01.00	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.	
20.02.00	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.	
20.03.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS.	
20.04.00	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.	
20.05.00	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.	
20.06.00	User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.	
21.00.00	PROTECTION FEATURES	
21.01.00	The system offered shall incorporate adequate protection features, properly coordinated for the drive control and for motor including following:	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	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.	
21.02.00	Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.	
22.00.00	CONTROL FEATURES	
22.01.00	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	
22.02.00	DIAGNOSTIC FEATURES	
22.02.01	The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.	
22.02.02	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	

CLAUSE NO.	TECHNICAL REQUIREMENTS 
	electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.
22.03.00	SERVICEABILITY / MAINTAINABILITY
22.03.01	Front Access: VFD system should be designed for front access only. Manufacturer shall state in his proposal if rear access is provided.
22.03.02	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.
22.03.03	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.
23.00.00	STORAGE AND PRESERVATION
23.01.00	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. Vendor shall submit powering requirement (if any) during storage.
24.00.00	TESTS
24.01.00	ROUTINE TESTS
	All acceptance and routine tests as per the specification and standard IEC -61800-2 and IEC 61800-4 shall be carried out.
24.02.00	TYPE TESTS
	The Contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the tests 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. In case 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 case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Employer and submit the reports for approval.
24.02.01	LIST OF TYPE TESTS
	a) VFD panels (For LV VFD) i. Rated Current/ Output ii. Temperature rise test iii. Surge withstand capability test iv. Noise level test v. Power Loss Determination Test vi. Power factor measurement.

CLAUSE NO.	TECHNICAL REQUIREMENTS 
	vii. Degree of Protection Test viii. EMC Test b) VFD Panels (For MV VFD) i. Rated Current/ Output ii. Current Sharing iii. Voltage Division iv. Temperature rise test v. Surge withstand capability test vi. Noise level test vii. Power Loss Determination Test viii. Power factor measurement. ix. Degree of Protection Test c) AC/DC Reactor (If applicable) i. Lightning impulse test ii. Heat run test iii. Short time current test iv. Noise level test d) Induction motors i. As per requirements mentioned in subsection for motor. e) VFD transformers i. As per requirements mentioned in subsection for Transformer/ IEC 60076/IS 2026

CLAUSE NO.	TECHNICAL REQUIREMENTS			
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			
LOT-1A PROJECTS, 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			
	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.			



SPECIFICATION FOR LOCAL PANELS

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

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 1 OF 6

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

Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)

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.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	2 OF 6

- 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



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	3 OF 6

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.



SPECIFICATION FOR LOCAL PANELS

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

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 4 OF 6

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.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	5 OF 6

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



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	6 OF 6

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.

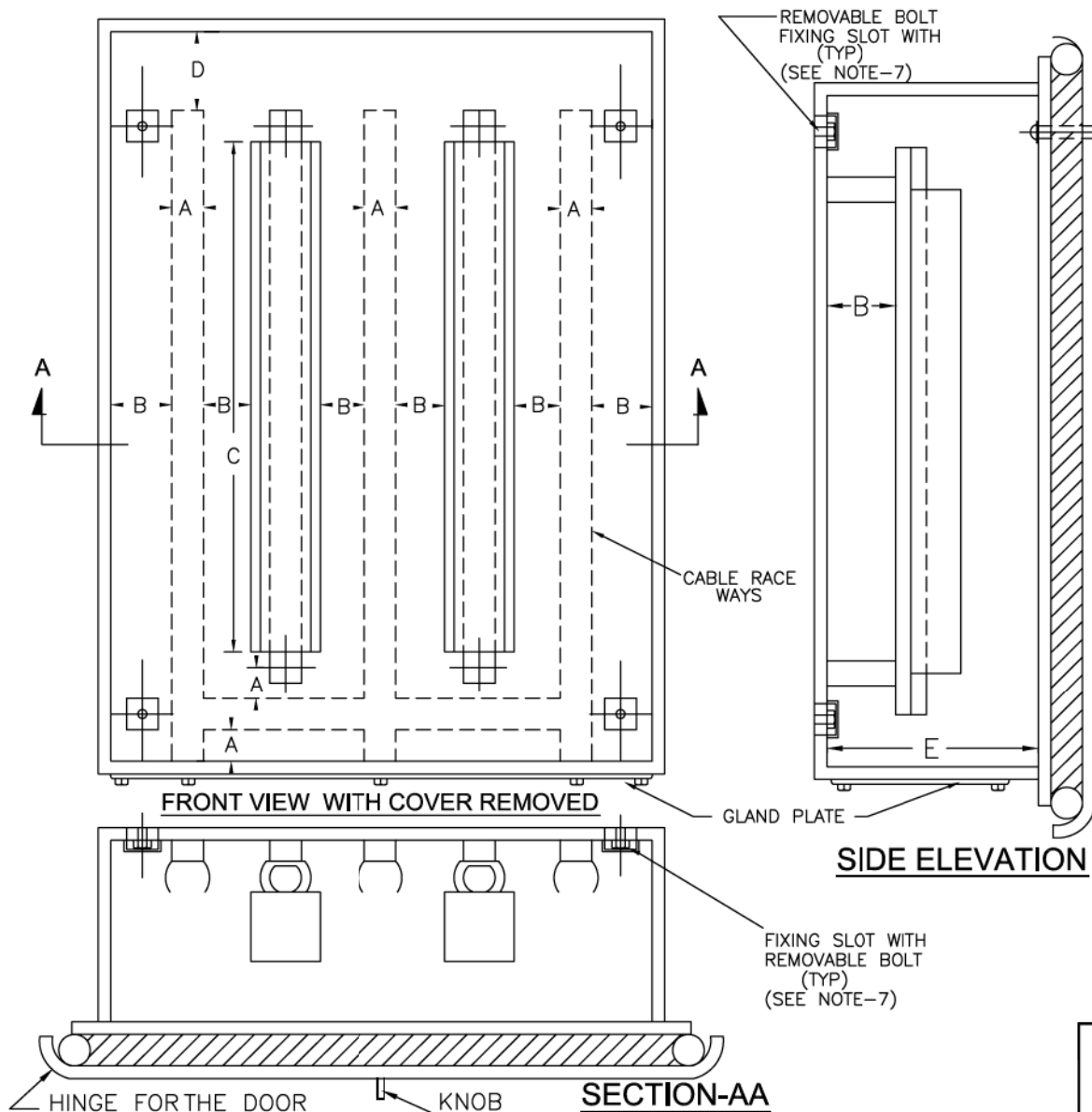
7.0 MARKING AND PACKING

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 |



FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

												PROJECT TYPICAL THERMAL POWER PLANT			
D	GENERALLY REVISED		JM	KS							21.08.12	TITLE G.A. OF JUNCTION BOX			
C	GENERALLY REVISED		JM	KS							04.08.06				
B	GENERALLY REVISED	S.K.	A.R	PS											
A	FIRST ISSUE	S.K.	A.R	PS							04.05.05				
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
					Page 250 of 522							0000-999-POI-A-017	D		
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**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

SECTION: C
SUB SECTION: C&I

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

|

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 materia 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	Other type of cables like fiber optic/co-axial cables for system bus, 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			
	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.	
LOT-IA PROJECTS 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	
LOT-IA PROJECTS 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
LOT-IA PROJECTS 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 3 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	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.
LOT-IA PROJECTS 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 4 OF 13					

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
	Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
	Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
	Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
	G. Electrical Parameters				
	Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km	120 nF/km for F type 100 nF/km for G-type		200 nF/km
	Insulation Resistance (Min.)	100 M Ohm/Km			
	Cross Talk Figure (Min.) At 0.8 Khz	60 dB	60 dB		60dB
	Characteristic Impedance (Max) At 1 Khz	N.A.	320 OHM FOR F-TYPE 340 OHM FOR G-TYPE		N.A.
	Attenuation Figure At 1 Khz (Max)	N.A.	1.2 db/km		N.A.
	H. COMPLETE CABLE				
	Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.
	LOT-IA PROJECTS 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

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	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					
LOT-IA PROJECTS 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 6 OF 13	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.				
4.00.00	SPCIFICATION 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				
	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
LOT-IA PROJECTS 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 7 OF 13	

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				
LOT-IA PROJECTS 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 8 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	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. (i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. (ii) Power supply and internal illumination.	0.5 Sq.mm. 2.5Sq.mm. minimum (shall be as per load requirement.)	
LOT-IA PROJECTS 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 9 OF 13

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:			
	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	
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			
	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,		
LOT-IA PROJECTS 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 10 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	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 buried 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.		
LOT-IA PROJECTS 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 11 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																								
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 <table><tr><td>(i)</td><td>No. of ways</td><td>12/24/36/48/64/72/96/128 with 20% spares terminals.</td></tr><tr><td>(ii)</td><td>Material and Thickness</td><td>4mm thick Fiberglass Reinforced Polyester (FRP).</td></tr><tr><td>(iii)</td><td>Type</td><td>Screwed at all four corners for door. Door gasket shall be of synthetic rubber.</td></tr><tr><td>(iv)</td><td>Mounting clamps and accessories</td><td>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.</td></tr><tr><td>(v)</td><td>Type of terminal blocks</td><td>Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². A M6 earthing stud shall be provided.</td></tr><tr><td>(vi)</td><td>Protection Class</td><td>IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.</td></tr><tr><td>(vii)</td><td>Grounding</td><td>To be provided.</td></tr><tr><td>(viii)</td><td>Color</td><td>RAL 7035</td></tr></table>				(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
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(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																											
LOT-IA PROJECTS 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																								

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	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 JB's 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.			
LOT-IA PROJECTS 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 13 OF 13	



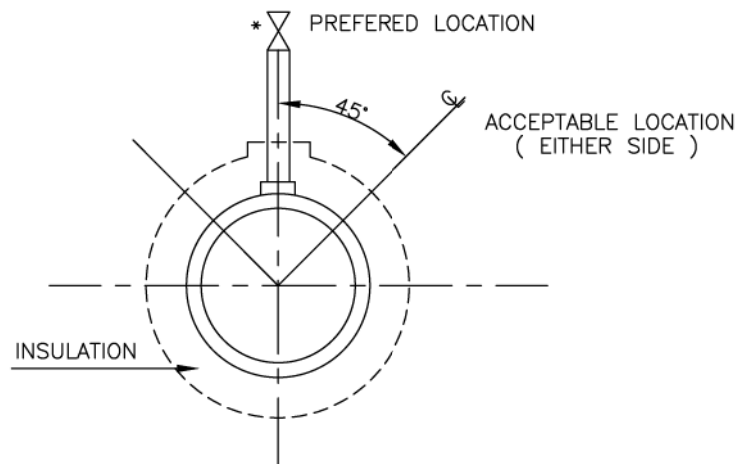
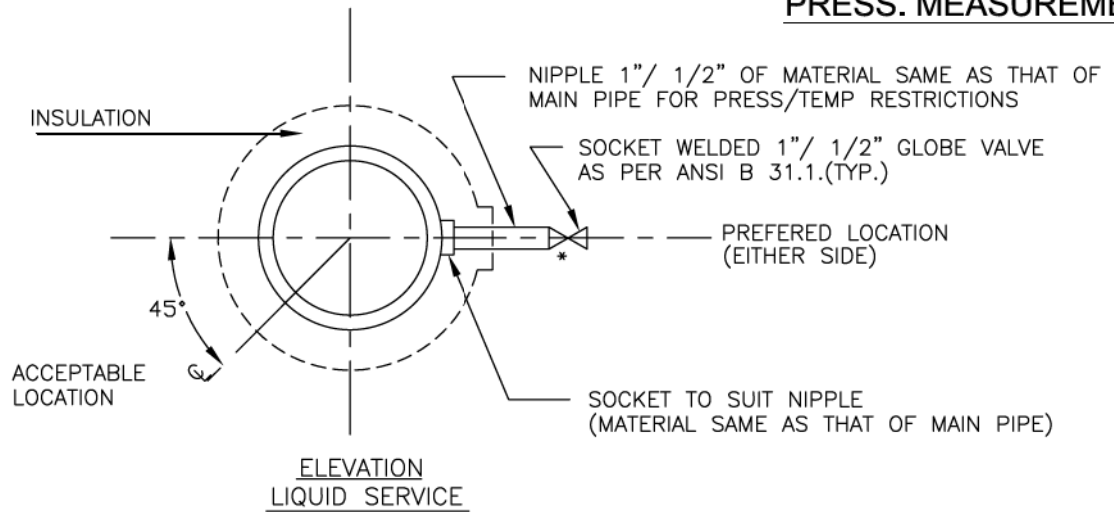
**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

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SUB SECTION: C&I

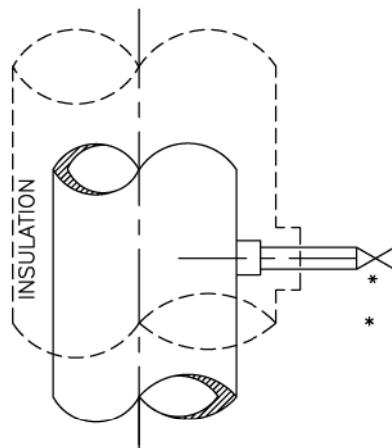
INSTRUMENT STUB DETAILS

|

PRESS. MEASUREMENT



PRESSURE CONNECTION ON HORIZONTAL PIPE



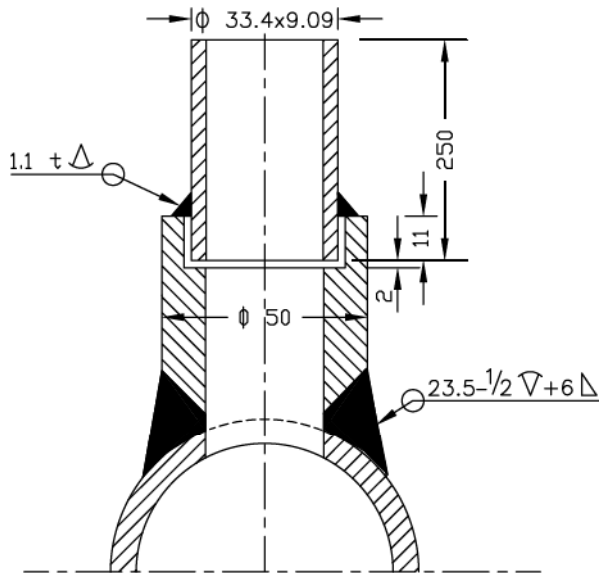
PRESSURE CONNECTIONS ON VERTICAL PIPES

FOR TENDER PURPOSE ONLY

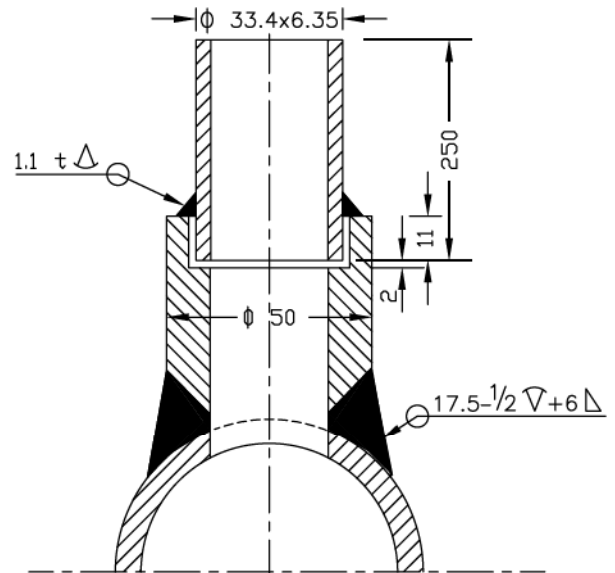
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PROJECT										TYPICAL THERMAL POWER PROJECT							
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS							
A	FIRST ISSUE							T.G.	21.08.12	SIZE	A4	SCALE	N.T.S.	DRG. NO.	0000-999-POI-A-035	REV. NO.	A
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE						
Cleared By										Page 266 of 522							
										Sh-1 Of 14							

PRESSURE MEASUREMENT

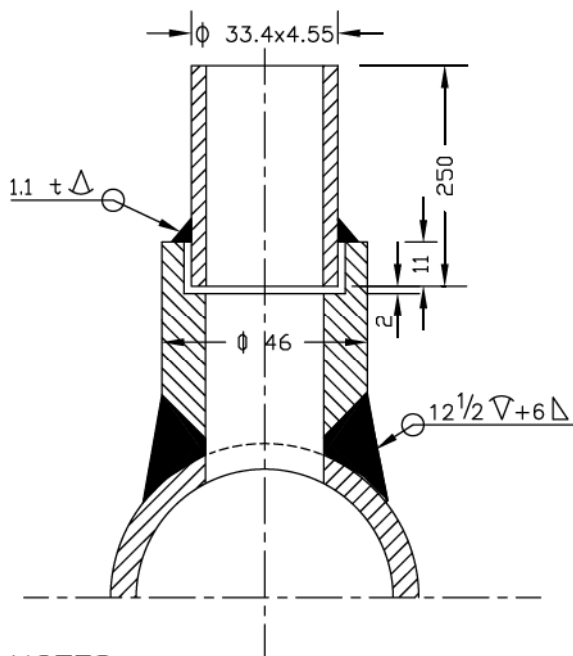
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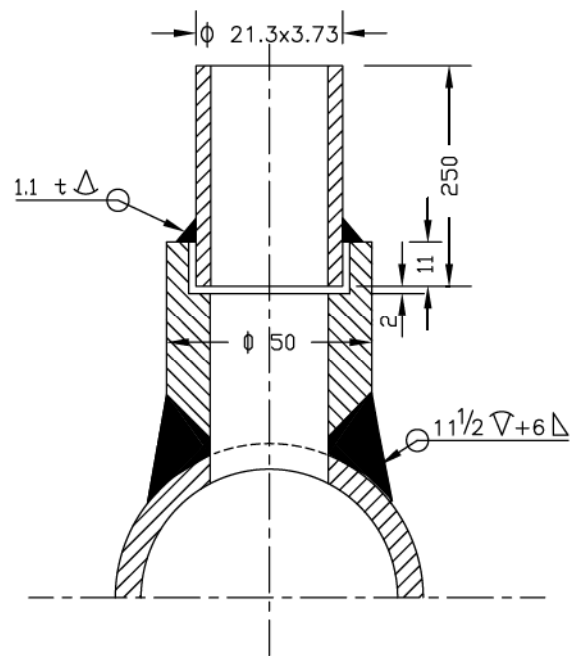
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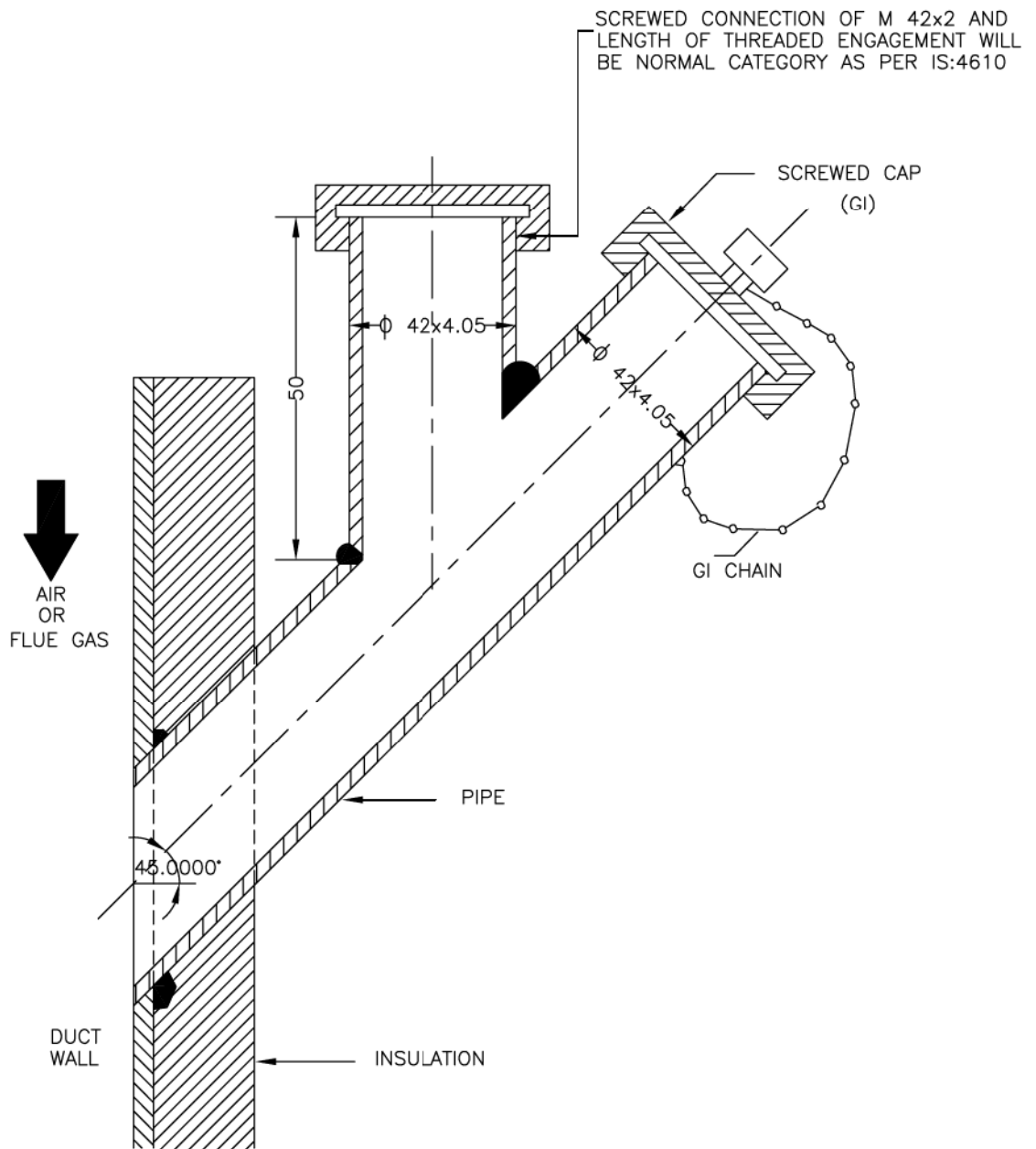
NOTES:-

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 Kg/Cm2.
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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PROJECT TYPICAL THERMAL POWER PROJECT															
TITLE INSTRUMENT SOURCE CONNECTION DETAILS															
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE											A4	N.T.S.	0000-999-POI-A-035	A
CLEAR BY										Sh-2 Of 14					

PRESS. MEASUREMENT



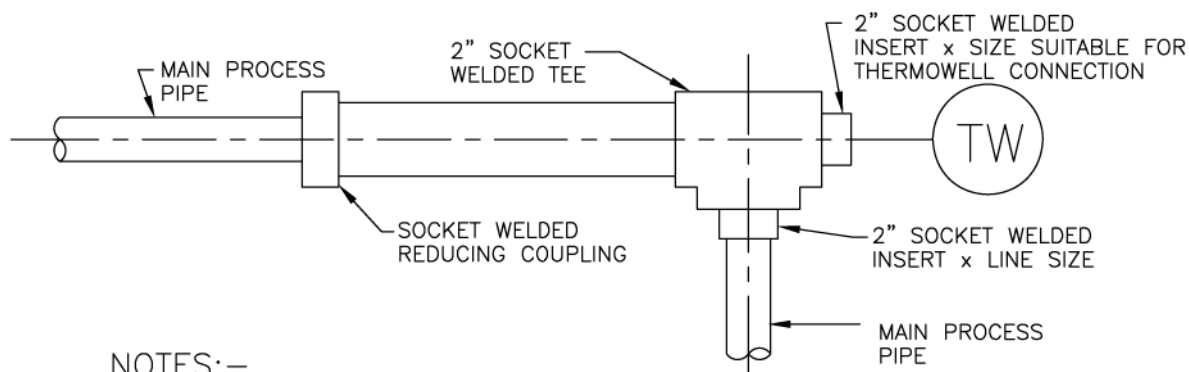
NOTES:—

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

FOR TENDER PURPOSE ONLY

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PROJECT										TYPICAL THERMAL POWER PROJECT							
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS							
A	FIRST ISSUE									T.G.		01.06.12					
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	0000-999-POI-A-035	REV. NO.	A
Cleared By										A4		N.T.S.		Sh-3 Of 14			

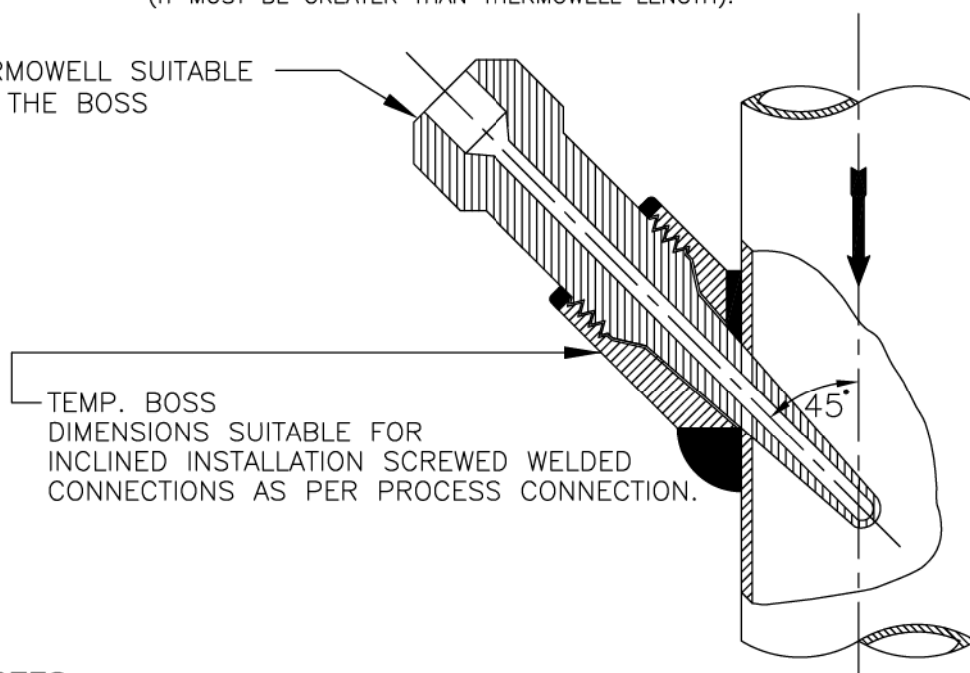
TEMP. MEASUREMENT



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



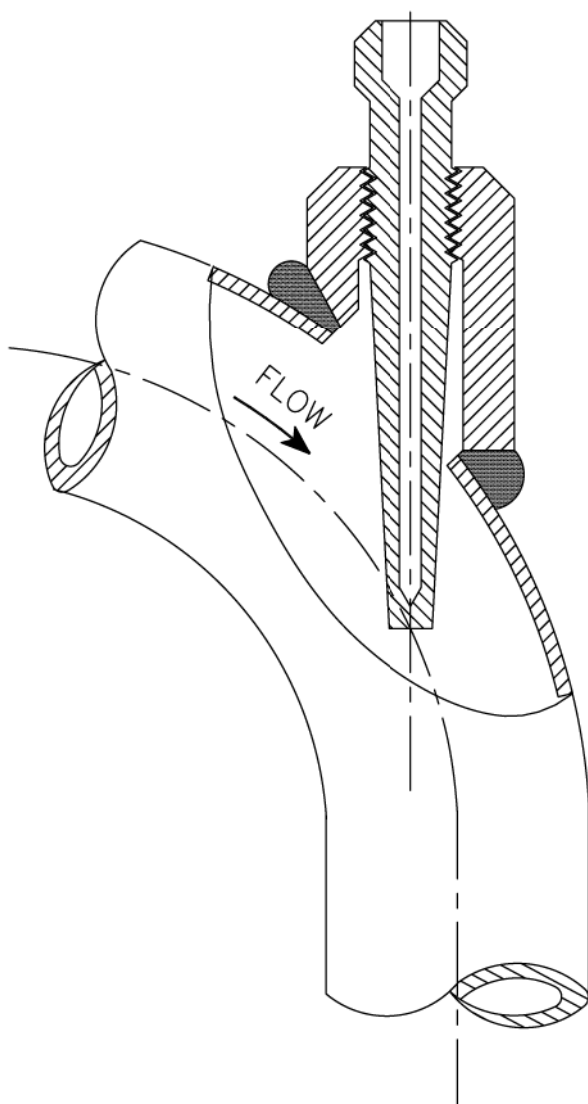
NOTES:—

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															
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A	FIRST ISSUE											A4	N.T.S.	0000-999/102-POI-A-035	A
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TEMP. MEASUREMENT



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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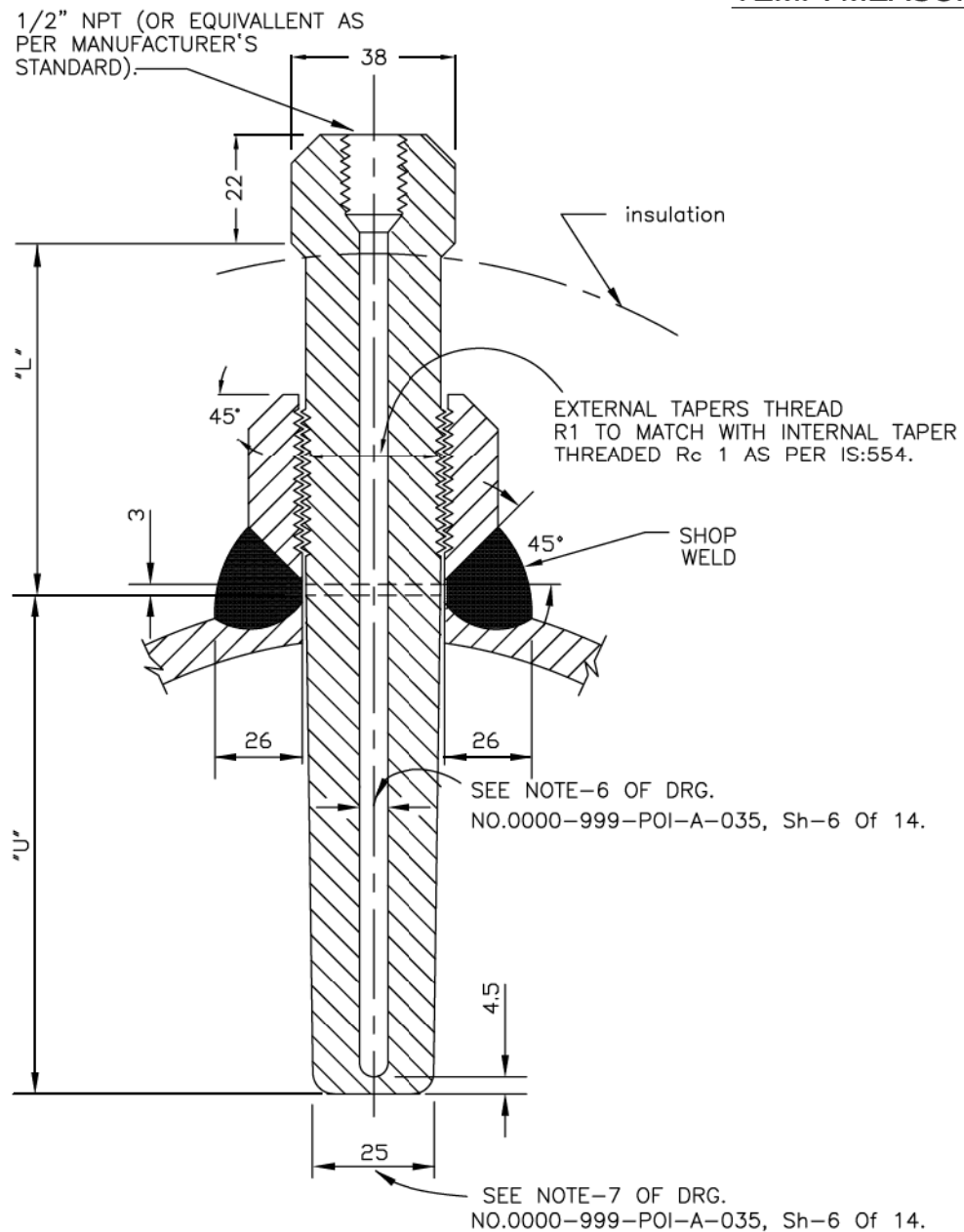
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A FIRST ISSUE												T.G. 31.08.12			
REV. NO. DESCRIPTION												DRAWN DESIGN CHKD. M E C C&I ARCH. APPD. DATE			
CLEAR BY Page 270 of 522												SIZE A4 N.T.S. DRG. NO. 0000-999-POI-A-035 REV. NO. A			
												Sh-5 Of 14			



- FOR TENDER PURPOSE ONLY

Page 271 of 522

TEMP. MEASUREMENT



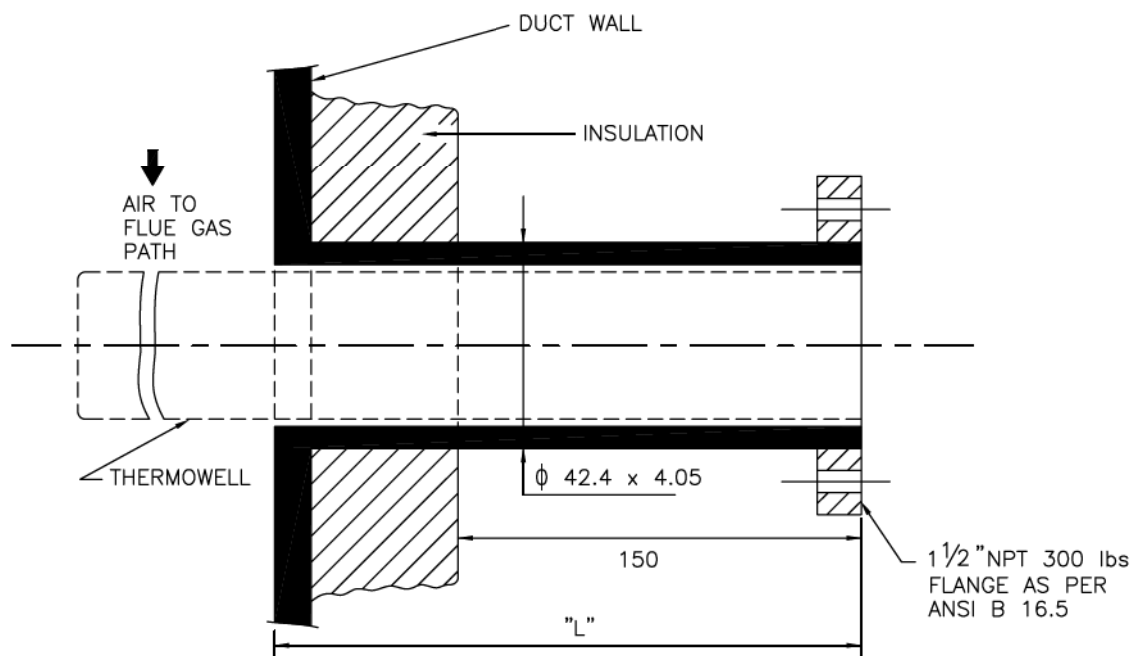
NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm²(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

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												TITLE INSTRUMENT SOURCE CONNECTION DETAILS						
A		FIRST ISSUE								T.G.		31.08.12						
REV. NO.	DESCRIPTION			DRAWN	DESIGN	CHKD.	M	E	C	CL	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	0000-999-POI-A-035	REV. NO.
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TEMP. MEASUREMENT



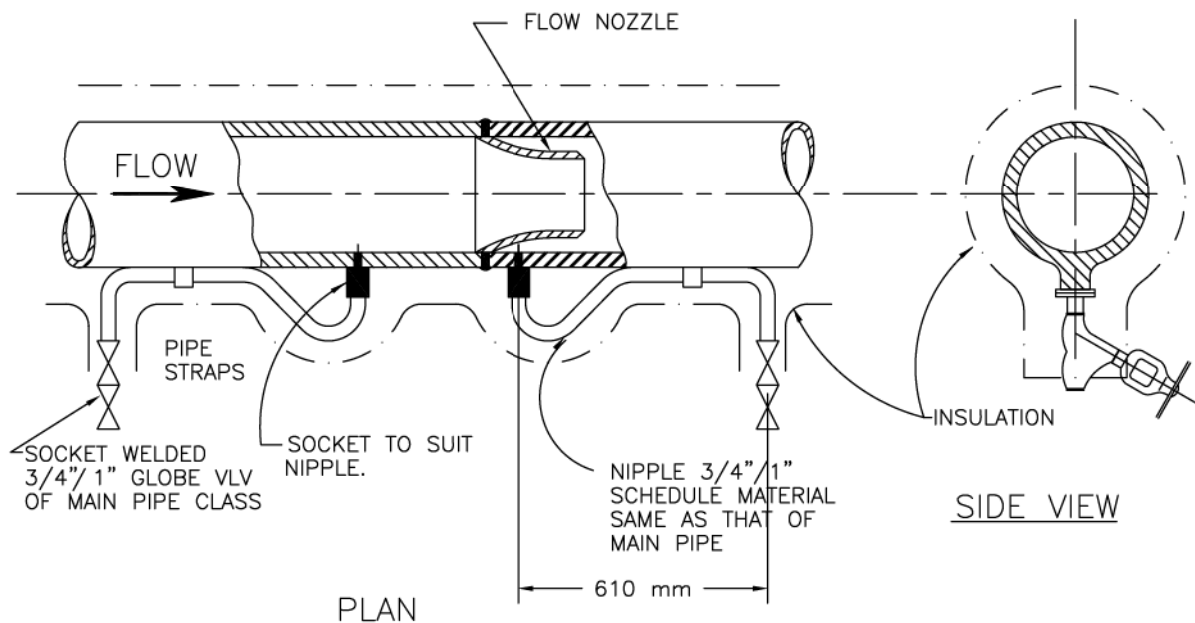
NOTES:—

1. THIS TYPE OF TEMPERATURE CONNECTIONS SHALL BE PROVIDED FOR TEMPERATURE MEASUREMENT IN AIR AND FLUE GAS DUCT.
2. MATERIAL OF THERMOWELL SHALL BE OF 316SS.
3. EXTERNAL CONNECTION SHALL BE OF SLIP ON FLANGED TYPE AND THERMOWELL DESIGN SHALL BE AS PER ASME.PTC-19.3 (REFER NOTES 9&10 OF DRG.NO. 0000-999-POI-A-035, Sh-6 Of 14).
4. BIDDER TO SUPPLY AND INSTALL THE COUNTER FLANGED AND THERMOWELL (ALONG WITH TEMP. ELEMENT).
5. ALL DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

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TITLE										INSTRUMENT SOURCE CONNECTION DETAILS	
A	FIRST ISSUE									T.G.	01.08.12
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
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										DRG. NO.	0000-999-POI-A-035
										REV. NO.	A

FLOW MEASUREMENT



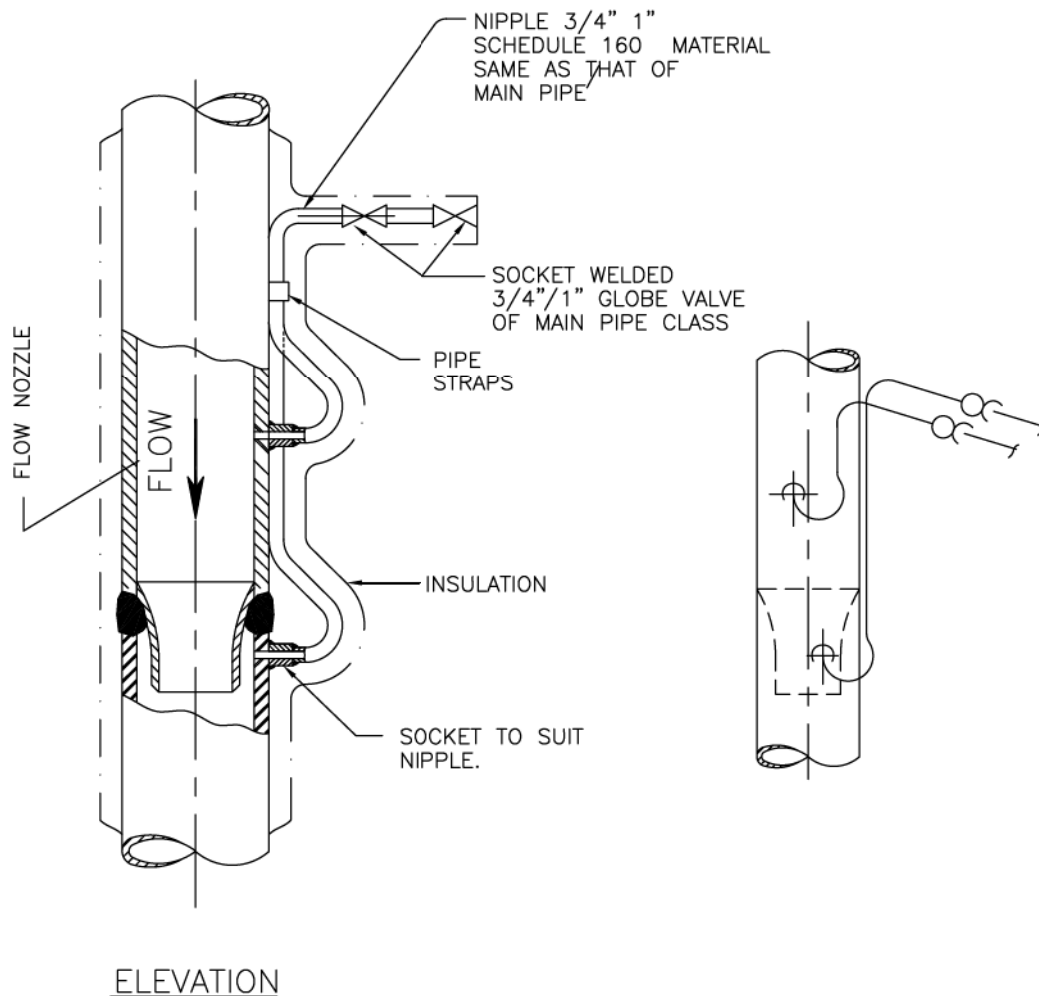
NOTES:-

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE HORIZONTAL PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM AT TEMP. ABOVE 455°C .
2. FOR STEAM SERVICE IN HORIZONTAL PIPE THE PRESSURE HOLES AND CONNECTING NIPPLES SHOULD BE IN THE HORIZONTAL PLANE OF THE PIPE CENTRE LINE.
3. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
4. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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FLOW MEASUREMENT

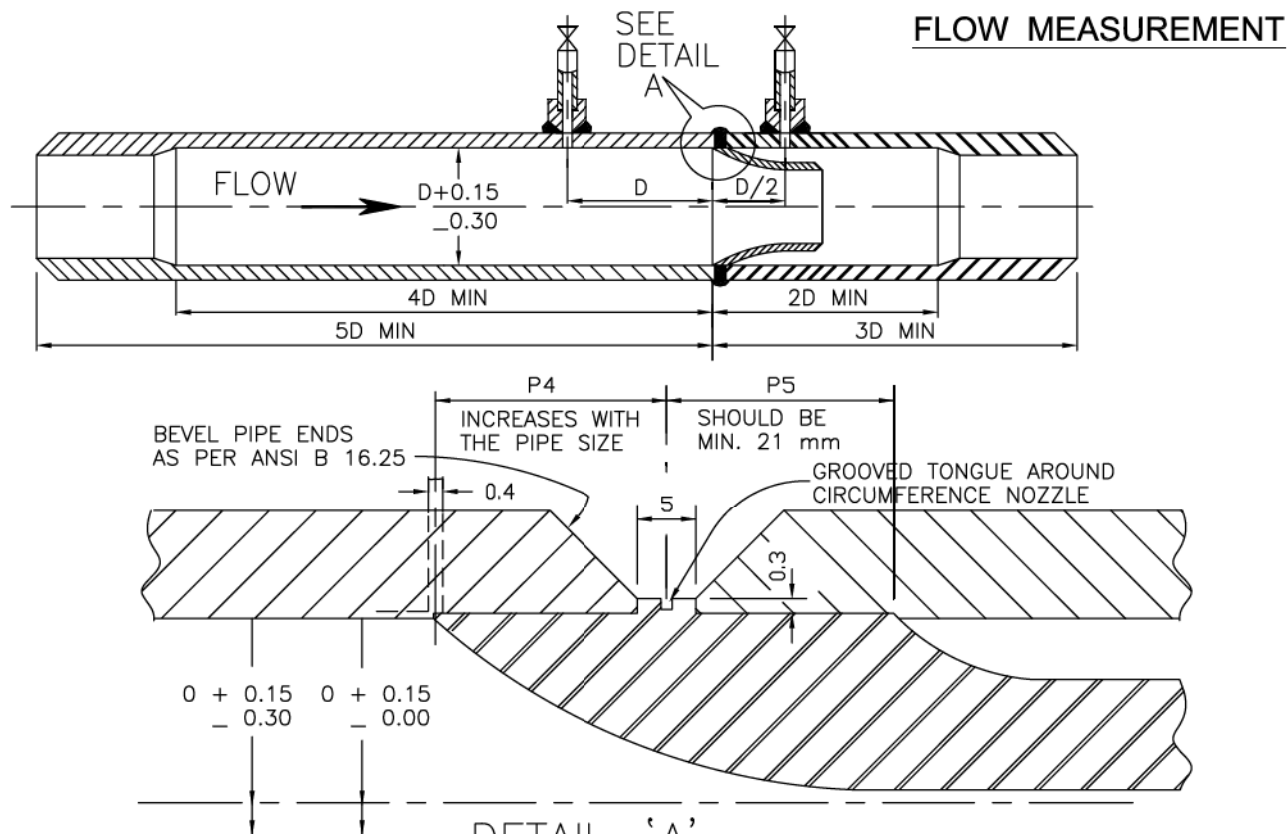


NOTES:—

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE VERTICAL STEAM PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM AT TEMP. ABOVE 455°C
2. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
3. ON VERTICAL STEAM PIPE BOTH HIGH TEMPERATURE (SPECIAL VENTS) NIPPLES WILL BE LONG ENOUGH SO THAT HIGH AND LOW PRESSURE CONNECTION NIPPLES WILL BE AT SAME LEVEL.
4. UP STREAM AND DOWN STREAM PRESSURE CONNECTIONS MUST BE INSTALLED IN DIFFERENT PLANES PASSING THROUGH THE CENTRE OF THE PIPE.
5. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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										TITLE				INSTRUMENT SOURCE CONNECTION DETAILS							
A FIRST ISSUE REV. NO. DESCRIPTION DRAWN DESIGN CHKD. M E C T.G. C&I ARCH. APPD. DATE 01.08.12										SIZE		SCALE		DRG. NO.		0000-999-POI-A-035		REV. NO.		A	
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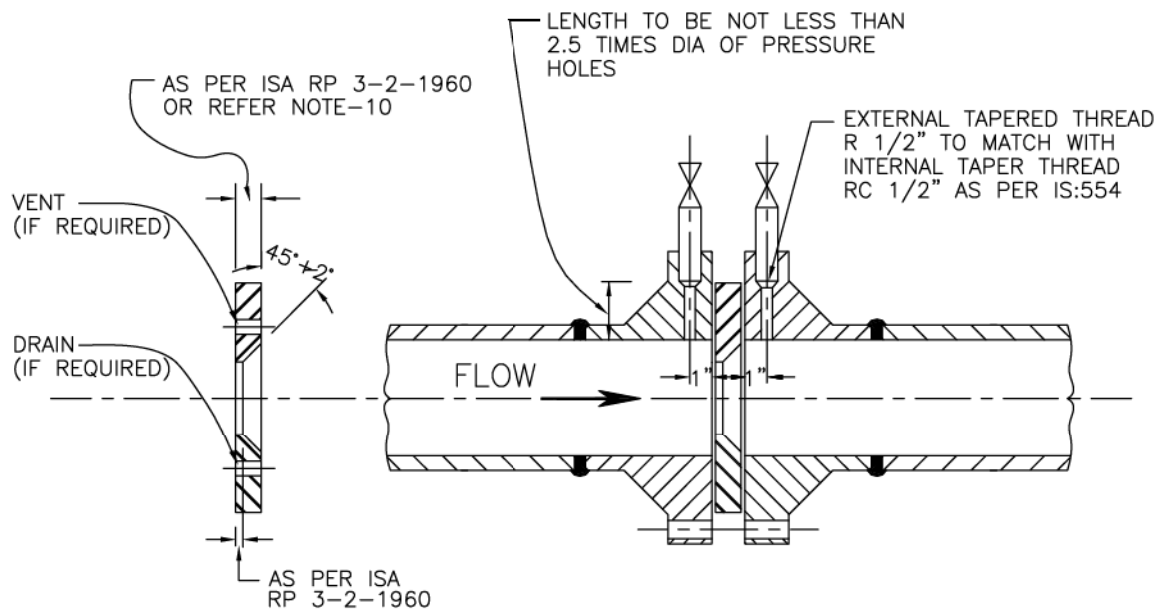
NOTES:-

1. COMPLETE FLOW NOZZLE BRANCH ASSEMBLY ALONG WITH NIPPLES AND SOURCE ISOLATION VALVES SHALL BE SUPPLIED BY THE BIDDER. THE BIDDER ALSO TO INSTALL FLOW NOZZLE WITHIN THE MACHINED BRANCH, PRESSURE STUBS ON THE BRANCH PIPE (FOR ORIENTATION OF PRESSURE TAP REF. NOTE-3) ALONG WITH NIPPLE AND SOURCE ISOLATION VALVES.
2. THE MACHINING OF BRANCH PIPE SHOULD BE DONE AFTER PRESSURE CONNECTIONS HAVE BEEN WELDED TO PIPE AND ALSO EXTEND FOR ATLEAST 4D IN THE INLET SECTION, 2D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF FLOW NOZZLE. TOTAL BRANCH PIPE ASSEMBLY SHOULD BE ATLEAST A LENGTH OF 8D/5D IN THE INLET SECTION AND 3D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF THE FLOW NOZZLE AS SHOWN ABOVE.
3. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE LOCATED ON SIDES OF THE PIPE FOR LIQUID AND STEAM SERVICE AND ON THE TOP FOR DRY GAS SERVICE FOR PROCESS LIQUIDS, INSTALLATION OF PRESS. TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW HORIZONTAL FOR SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
4. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF DISTANCE SPECIFIED AND NUMBER OF PAIRS OF PRESSURE TAPS TO BE PROVIDED WILL BE AS PER FLOW MEASUREMENT DATA SHEET.
5. PRESSURE TAPS SHOULD BE DRILLED RADIALLY WITH RESPECT TO PIPE AND THIS DRILLING SHOULD BE DONE AFTER ANY COUPLING FOR ATTACHING THE PRESSURE TUBING HAS BEEN WELDED TO THE PIPE. THE HOLE WHERE IT BREAKS THROUGH THE INNER SURFACE OF THE PIPE MUST BE FREE OF BURRS OR WIRE EDGE AND CORNER OF EDGE HOLE LEFT ROUNDED VERY SLIGHTLY (1/64" RADIUS).
6. RECOMMENDED MAXIMUM DIAMETERS OF PRESSURE TAP HOLES IN THE BRANCH PIPES WILL BE AS PER EN ISO 5167:2003. THE DIAMETER FOR HOLE SHOULD REMAIN SAME FOR DISTANCE NOT LESS THAN 2.5 TIME OF DIA FROM THE INNER SURFACE OF THE PIPE.
7. FLOW NOZZLE SHALL BE CENTRED IN THE PIPE WITHIN 0.8 mm (1/32") OF THE PIPE AXIS. INSIDE DIAMETER MEASURED AT FOUR POINTS AT ANY CROSS SECTION SHALL NOT DIFFER BY MORE THAN 1%.
8. BRANCH PIPE SHALL BE AS PER MAIN PIPING MATERIAL SPECIFICATION. INTERNAL SURFACE OF BORED SECTIONS MUST BE SMOOTH AND STRAIGHT, FREE FROM SCALES, PITS, BURRS OR ANY IRREGULARITIES.
9. FLOW NOZZLE MATERIAL SHALL BE 316 SS AND THE DESIGN AS PER ASME.
10. MAXIMUM UPSTREAM AND DOWN STREAM STRAIGHT LENGTH REQUIRED FROM INLET FACE OF FLOW NOZZLE SHALL BE AS PER EN ISO 5167:2003.

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A	FIRST ISSUE								
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.
								APPD.	DATE
								SIZE	SCALE
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								DRG. NO.	0000-999-POI-A-035
								REV. NO.	A

FLOW MEASUREMENT



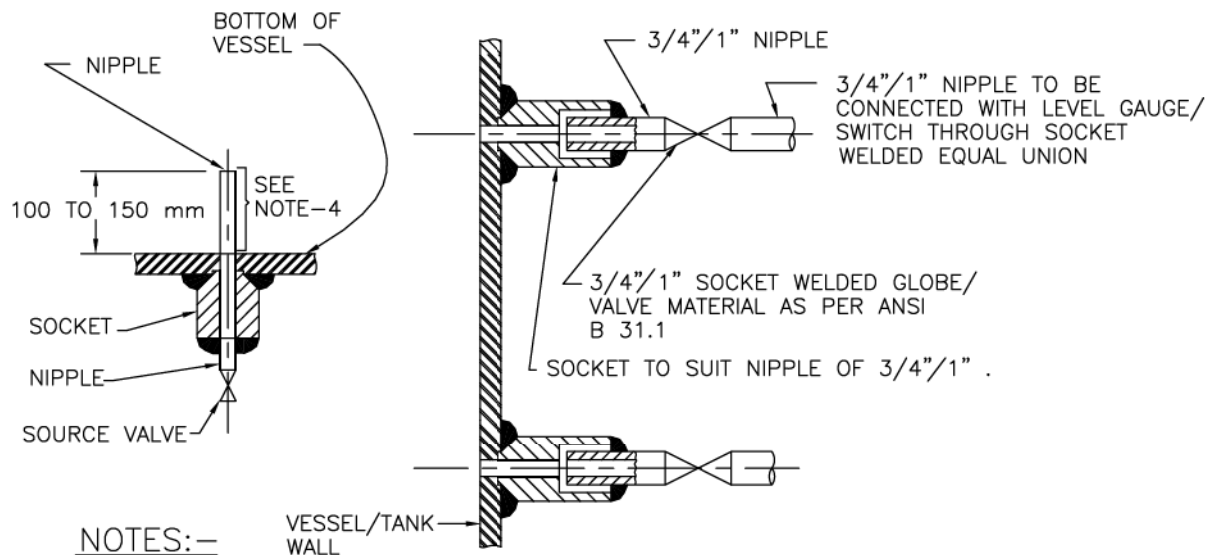
NOTES:—

- ORIFICE PLATE MOUNTED BETWEEN FLANGES WITH FLANGE TAPPING (AS SHOWN ABOVE) SHOULD BE LIMITED TO PIPE SIZES OF 2" OR LARGER.
- ORIFICE PLATE SHALL BE MOUNTED BETWEEN PIPING FLANGES WITH THE SHARP EDGE FACING UPSTREAM SUCH THAT CENTRE OF THE CONCENTRIC ORIFICE SHOULD BE WITHIN 0.79 mm (1/32") OF THE AXIS OF THE PIPE.
- TWO GASKETS SHALL BE INSERTED BETWEEN THE PLATE AND THE FLANGES AND INSIDE DIAMETER OF THE GASKETS SHOULD BE ATLEAST 1.5 mm (1/16") GREATER THAN THE INSIDE DIAMETER OF THE PIPE SO THAT THEY DO NOT PROTRUDE INTO THE PIPE.
- PIPING FLANGES SHALL BE ANSI WELD NECK, RAISED FACE TYPE. THE FLANGE IS TO BE ALIGNED WITH THE FACE PERPENDICULAR TO THE FLOW AXIS.
- BIDDER TO SUPPLY ORIFICE PLATE SPECIAL TYPE (HAVING PRESS. CONNECTIONS) OF FLANGES ALONG WITH GASKETS, NIPPLES AND SOURCE VALVES.
- ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE TAKEN FROM SIDES FOR LIQUID AND STEAM SERVICE AND FROM TOP FOR DRY GAS SERVICE. FOR PROCESS LIQUIDS INSTALLATION OF PRESSURE TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW THE HORIZONTAL IN SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
- THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF THE DISTANCE SPECIFIED.
- MAXIMUM DIAMETER OF PRESS. CONNECTION HOLES SHALL BE AS PER RECOMMENDATIONS OF ASME PTC 19.5. THE DIAMETER OF THE HOLE SHOULD REMAIN THE SAME FOR A DISTANCE NOT LESS THAN 2.5 TIMES OF THE DIAMETER BEFORE EXPANDING INTO THE PRESSURE PIPE.
- THERE MUST BE NO BURRS WIRE EDGES OR OTHER IRREGULARITIES ALONG THE EDGE OF THE HOLE AND IT MUST BE SQUARE AND ROUNDED SLIGHTLY (1/64" RADIUS).
- ORIFICE PLATE SHOULD BE FLAT WITHIN 0.02 mm (0.001") AND THE SURFACE ROUGHNESS SHOULD NOT EXCEED 20 MICRO INCH. THE THICKNESS OF THE ORIFICE PLATE SHOULD BE AS PER EN ISO 5167:2003.
- FOR HORIZONTAL PIPE RUN DRAIN HOLES IN ORIFICE PLATES ARE AT THE BOTTOM (APPROX. TANGENT TO INSIDE DIA OF PIPE) FOR STEAM OR GAS SERVICE. VENT HOLES SHOULD BE LOCATED ON UPPER SIDE FOR INCOMPRESSIBLE FLUID.
- ORIFICE PLATE SHOULD BE OF 316 SS (ASTM A167-54 GRADE-II).
- RECOMMENDED MINIMUM LENGTHS OF STRAIGHT PIPE PRECEDING AND FOLLOWING ORIFICES SHALL BE AS PER EN ISO 5167:2003.
- THREE PAIRS OF PRESSURE TAPS SHALL BE PROVIDED WITH NIPPLES OF REQUIRED LENGTH AND SOURCE VALVES AND THE UN-USED TAPS ARE PLUGGED.
- THE INTERNAL TAPERED CONNECTION WITHIN THE FLANGE FOR PRESSURE TAPS SHOULD BE RC 1/2" AND THE NIPPLE SHOULD ALSO OF EXTERNAL THREADED R 1/2" AS PER IS:554. THE LENGTH OF THREADED ENGAGEMENT SHALL BE AS PER ABOVE STANDARD.

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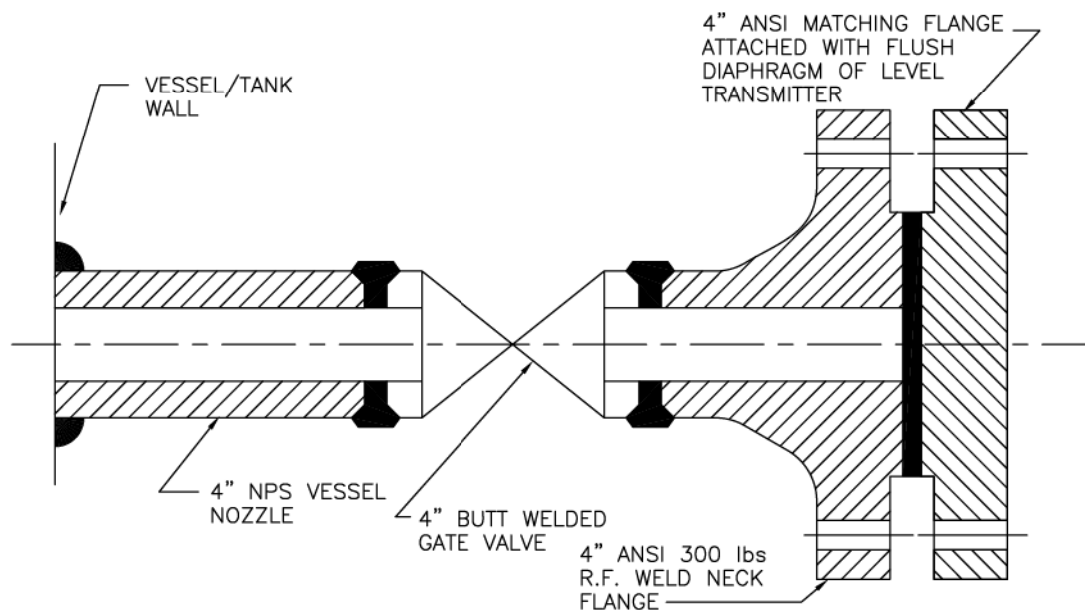
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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
Cleared By											
Page 277 of 522										SIZE	A4
										SCALE	N.T.S.
										DRG. NO.	0000-999-POI-A-035
										REV. NO.	A
										Sh-12 Of 14	

LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



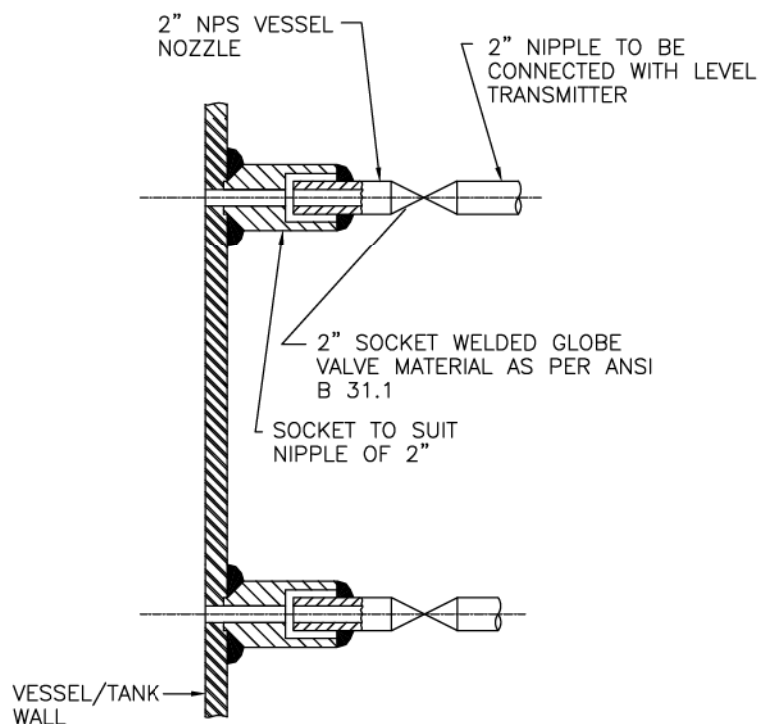
NOTES:—

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

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LEVEL MEASUREMENT



NOTES:—

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR DISPLACER TYPE LEVEL TRANSMITTER.
2. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
3. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.

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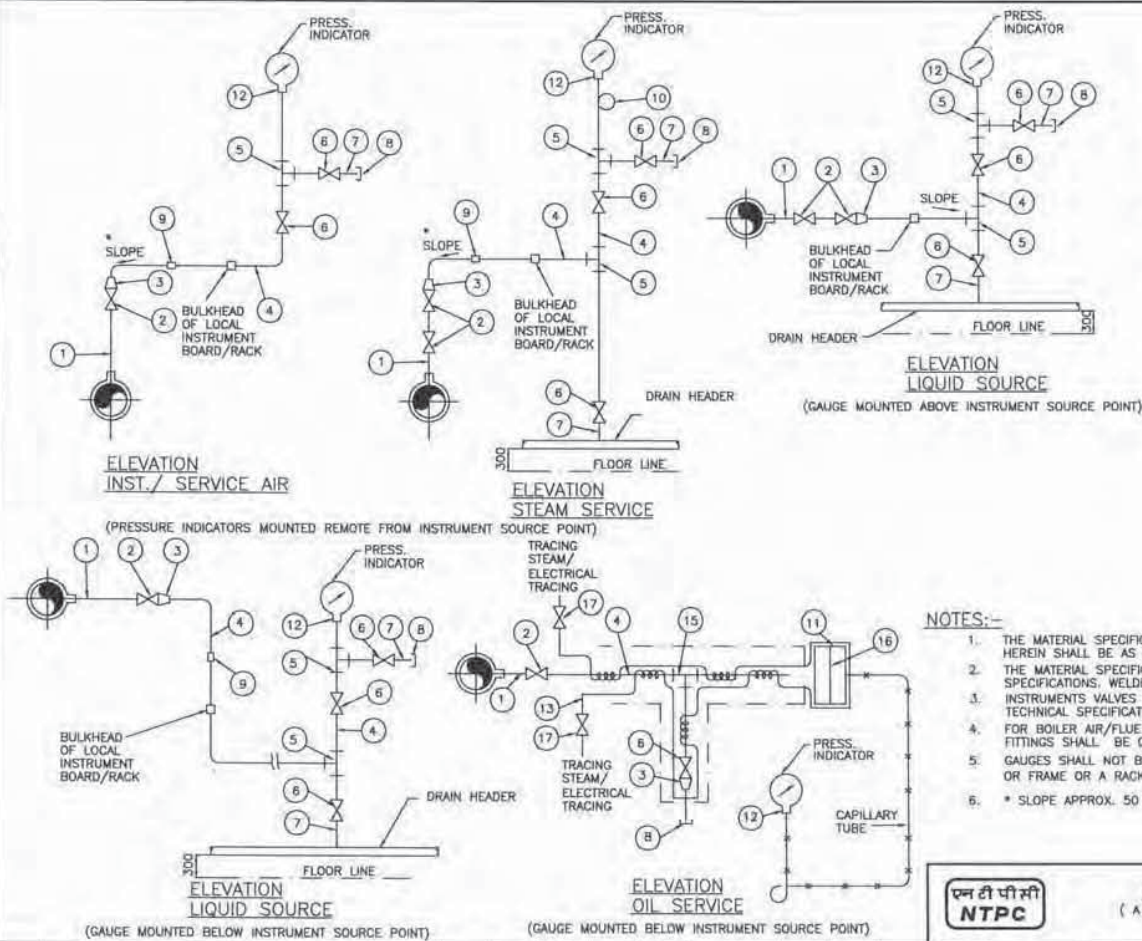


**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

SECTION: C
SUB SECTION: C&I

INSTRUMENT INSTALLATION DRAWING

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LIST OF MATERIALS	
ITEM NO.	DESCRIPTION
1.	1/2" x 3/4" x 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2" x 3/4" / 1" SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	8" SS SYPHON
11.	1/2" BLIND 300lb _{RF} ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER.
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1" x 3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS, 1/4" SW

NOTES:-

- THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
- THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFORM TO ANSI-B.16-11.
- INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
- FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
- GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
- * SLOPE APPROX. 50 MM / METRE.

FOR TENDER PURPOSE ONLY

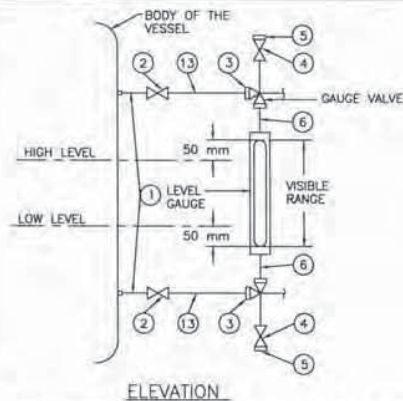


NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

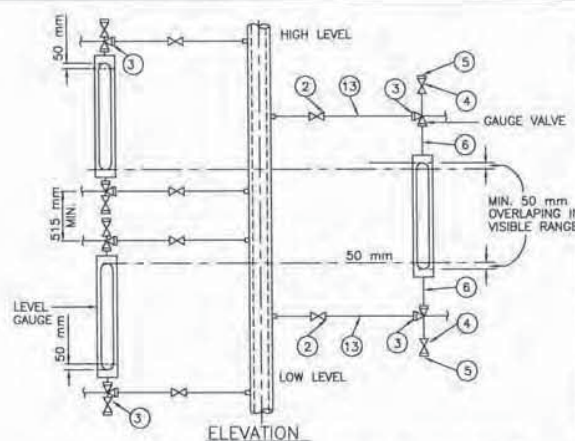
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)	
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A

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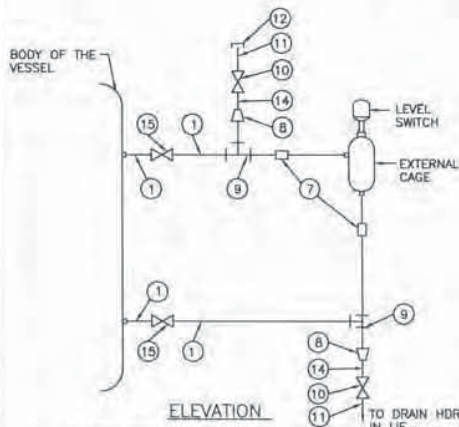


ELEVATION
LOCAL LEVEL INDICATION USING GAUGE GLASS

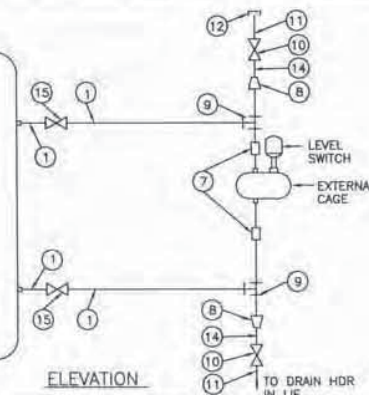


ELEVATION
LOCAL LEVEL INDICATION USING MULTIPLE GAUGES
FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT

LIST OF MATERIALS	
ITEM NO.	DESCRIPTION
1.	3/4" x 1" NPS SCH.40/80/160/P91 (AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2.	3/4" SW GLOBE VALVE.
3.	3/4" SW UNION.
4.	3/4" NPT GLOBE VALVE.
5.	3/4" NPT (M) CAP.
6.	3/4" NPT (F) UNION CONNECTION.
7.	1" SW EQUAL UNION.
8.	1" x 1/2" SW REDUCING INSERT.
9.	1" SW EQUAL TEE.
10.	1/2" SW GLOBE VALVE.
11.	1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
12.	1/2" NPT (F) CAP.
13.	3/4"x1/2" NPS SCH.40/80 CS/AS PIPE.
14.	1/2" NPS SCH.80/160 CS/AS NIPPLE.
15.	1" SW GLOBE VALVE.



ELEVATION
FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION



ELEVATION
TO DRAIN HDR. IN LIE

NOTES:-

1. FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.
2. NOTES UNDER DRG. NO. 0000-999-POI-A-023 (WHICHEVER ARE RELEVANT).

FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)	
SIZE	SCALE	DRG. NO.	REV. NO.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	PROCESS CONNECTION AND PIPING			
1.00.00	PROCESS CONNECTION PIPING			
1.01.00	The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.			
1.01.01	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS			
1.01.02	All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be 1/2" for Steam & Water Application and 3/4" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:			
	Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70		
	Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34		
	Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009		
	Installation Schemes	BS 6739-2009, ANSI/ISA 77.70		
	Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm ² or Temp>280 °C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.			
1.01.03	The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:			
	Manifold	Application/M Measurement		
	2 Valve	Pressure measurements using pressure transmitters/pressure switches		
	3 Valve	Pressure measurements using differential pressure transmitter/ switches		
	5 Valve	Differential Pressure, Flow and Level Measurements		
	For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .			
2.00.00	AIR SUPPLY PIPING			
2.01.01	All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.			
2.02.00	Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.			
2.03.00	The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2		SUB-SECTION-III-C3 PCP
PAGE 1 OF 4				

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.			
2.04.00	The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.			
2.05.00	All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.			
2.06.00	Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.			
3.00.00	INSTALLATION AND ROUTING			
3.01.01	All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe from the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided. Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.			
4.00.00	SHOP AND SITE TESTS			
4.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-III-E-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.			
4.01.02	Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.			
5.00.00	LOCAL INSTRUMENT ENCLOSURE AND RACKS All transmitters, switches etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of covered areas. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C3 PCP	PAGE 2 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.01.00	The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55. The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key. The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.			
	ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS			
	All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack. The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance. Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55. Enclosure and Racks shall be free standing type. Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C3 PCP	PAGE 3 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
6.00.00	INSTALLATION OF OTHER INSTRUMENTS: For installation and routing of other field mounted instruments which are not covered in Cl. No. 5.00.00, please refer Cl. No 52.04.00(J) of Section-VI, Part-D, Erection Conditions of Contract (ECC) of Technical Specifications.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C3 PCP	PAGE 4 OF 4



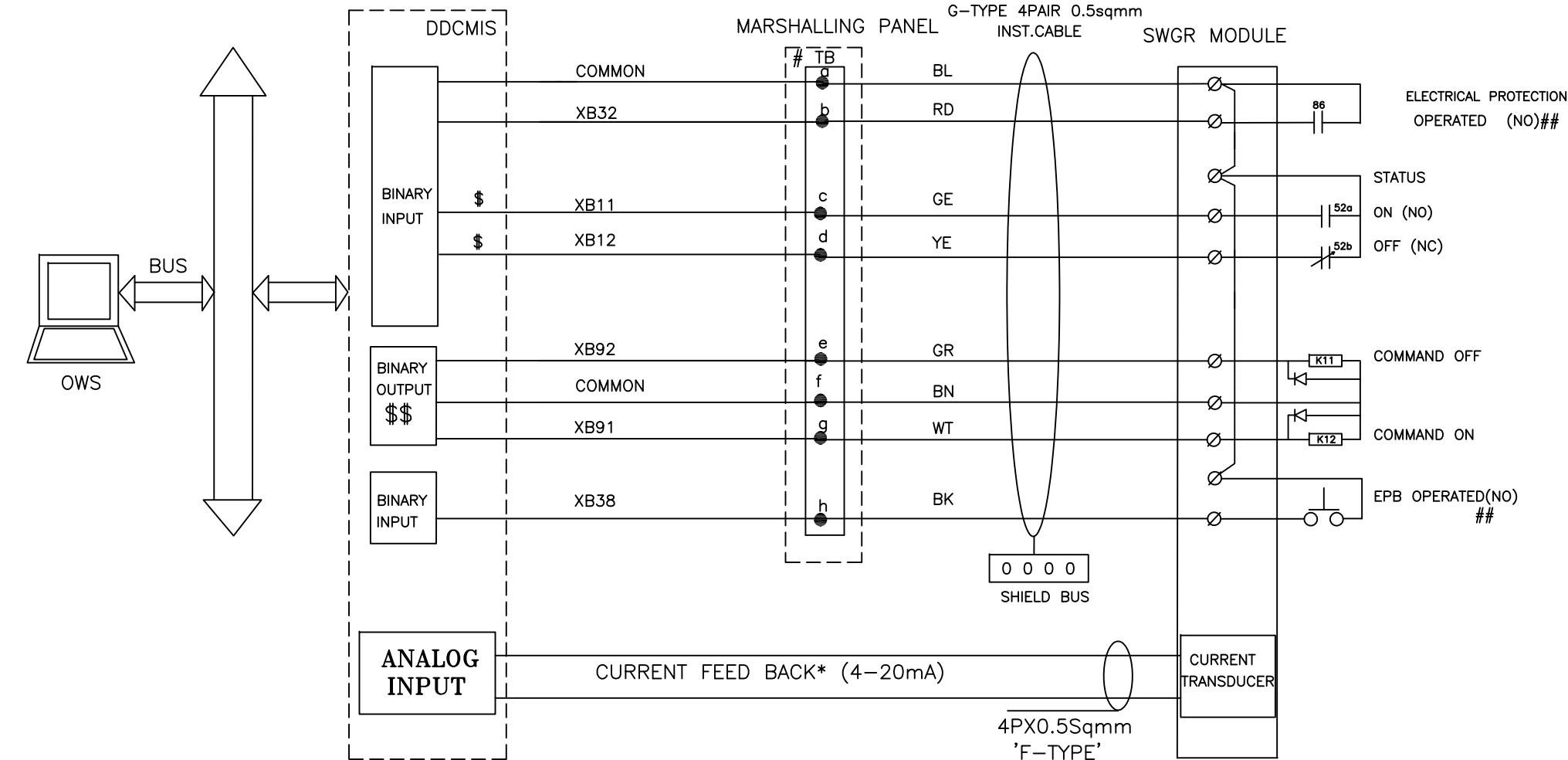
**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

SECTION: C
SUB SECTION: C&I

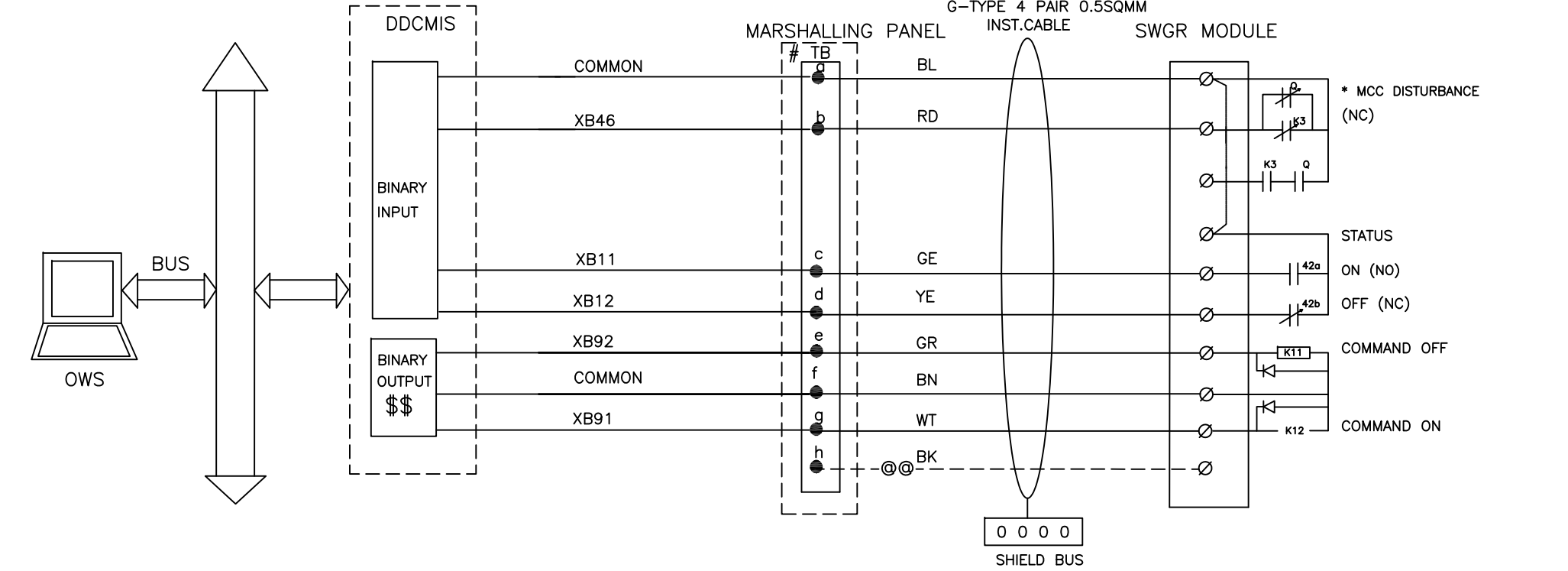
**SIGNAL INTERFACE
BETWEEN
DRIVES AND DCS**

|

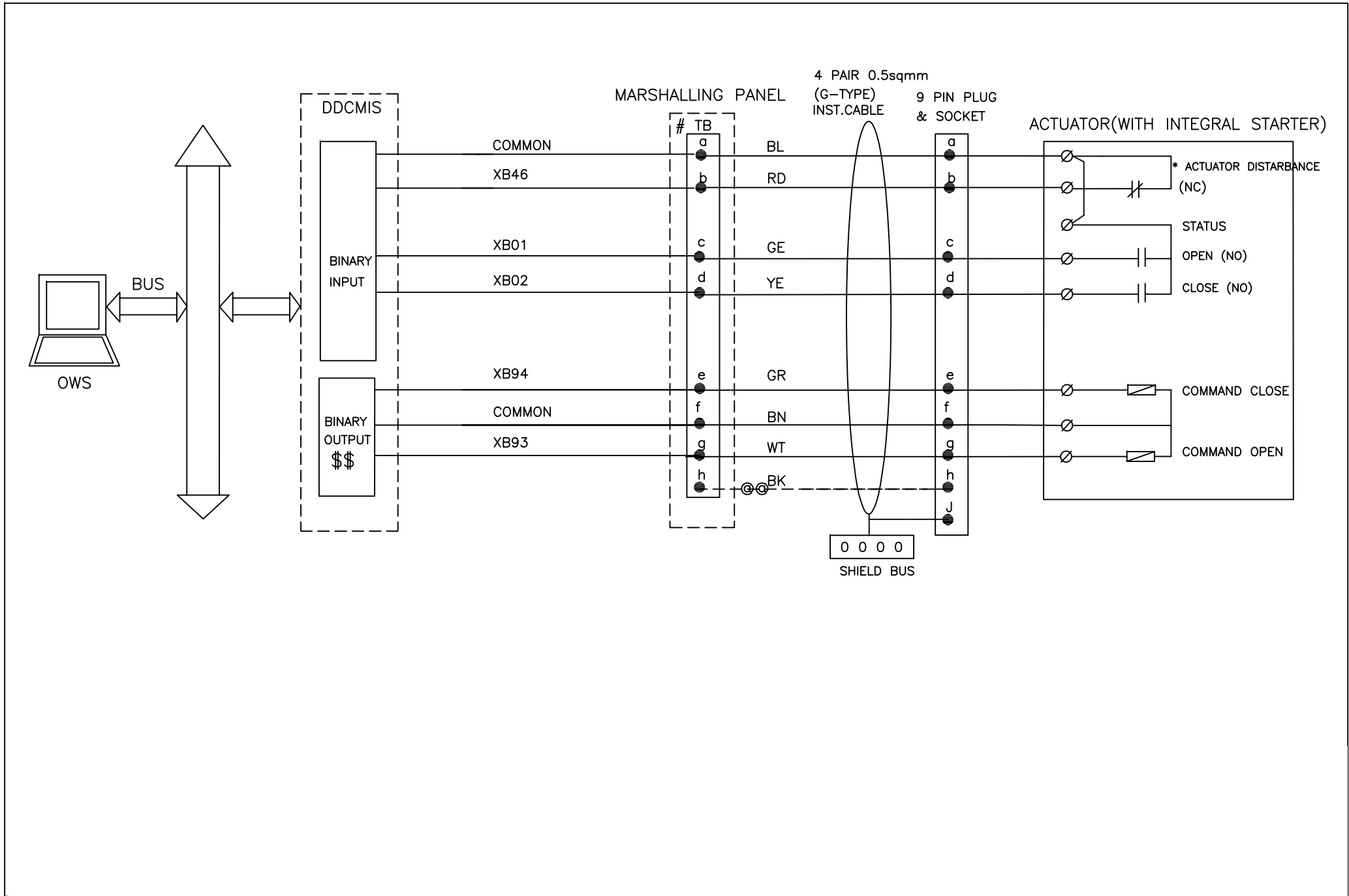
DDCMIS INTERFACE WITH HT SWITCH GEAR (HT)



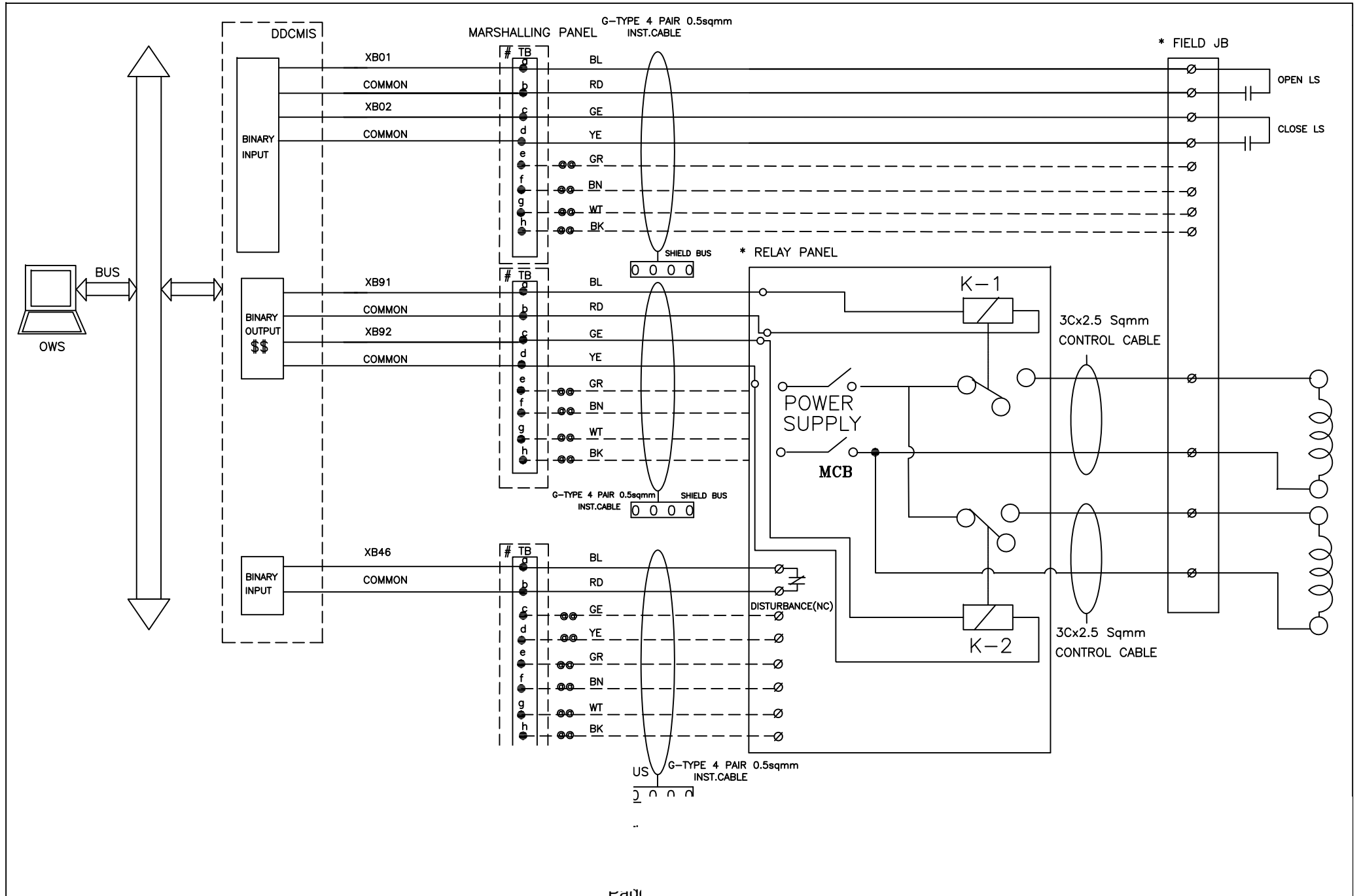
DDCMIS INTERFACE WITH LT MCC (LT)



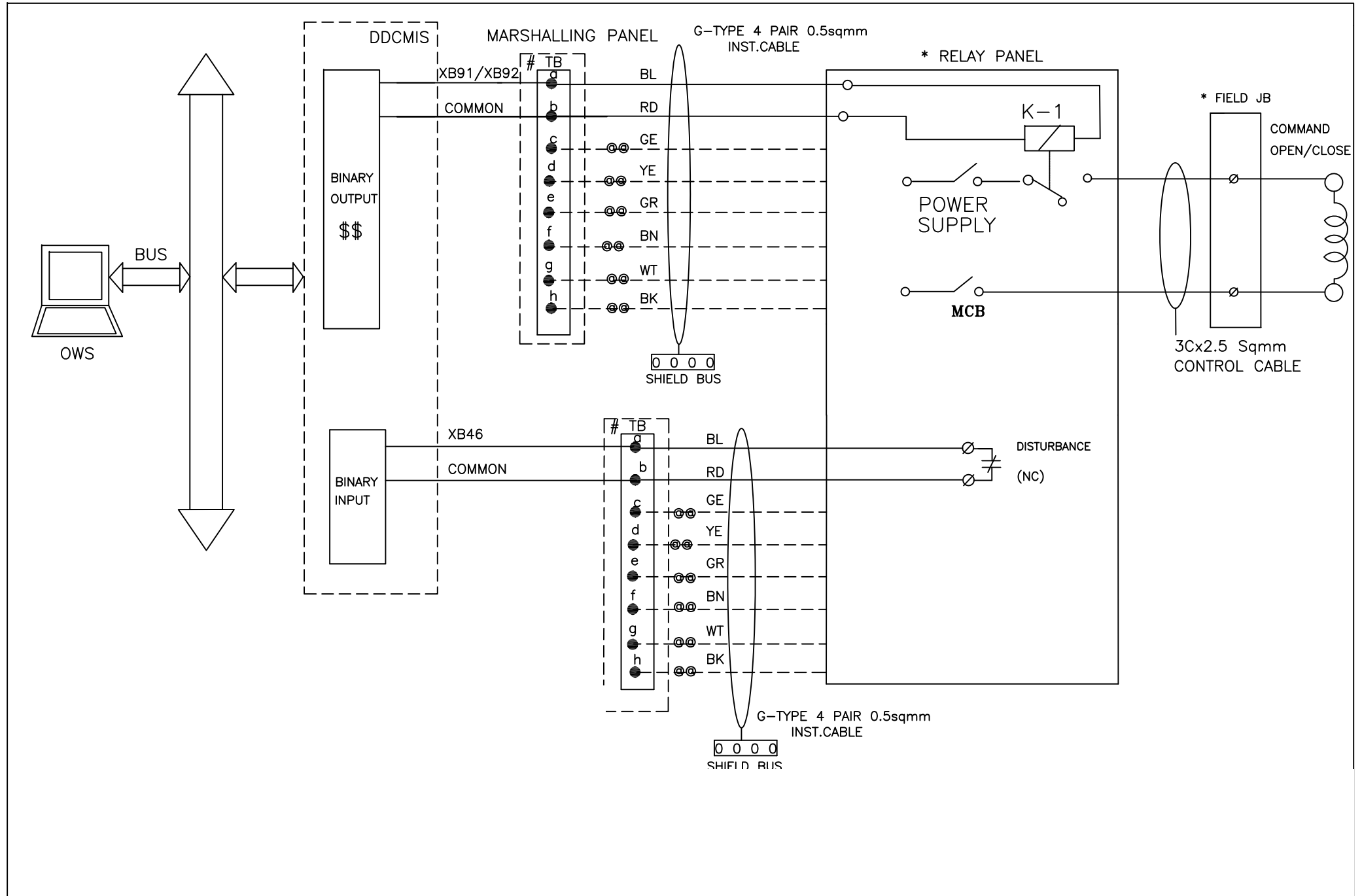
DDCMIS INTERFACE WITH BID

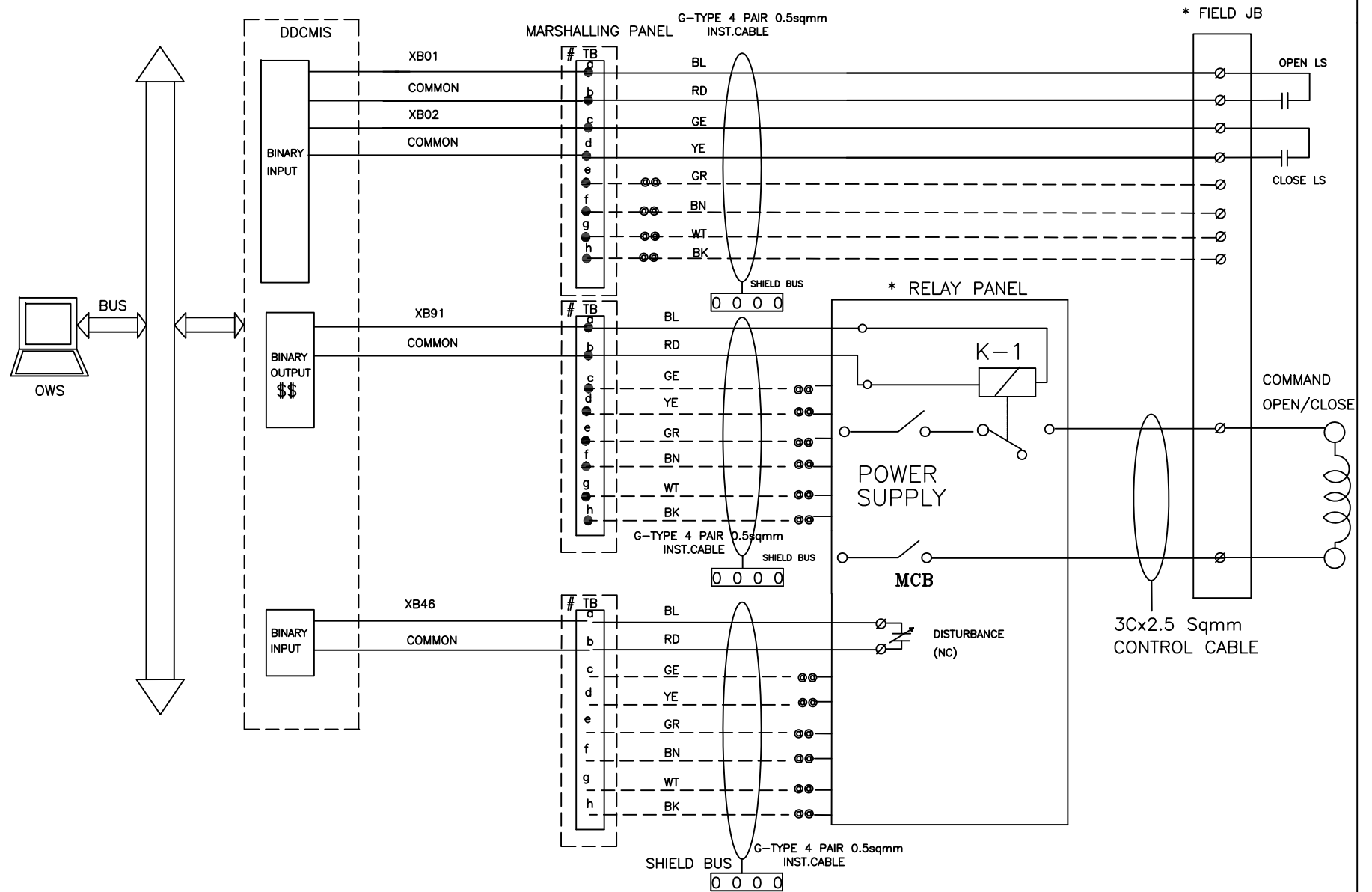


DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)

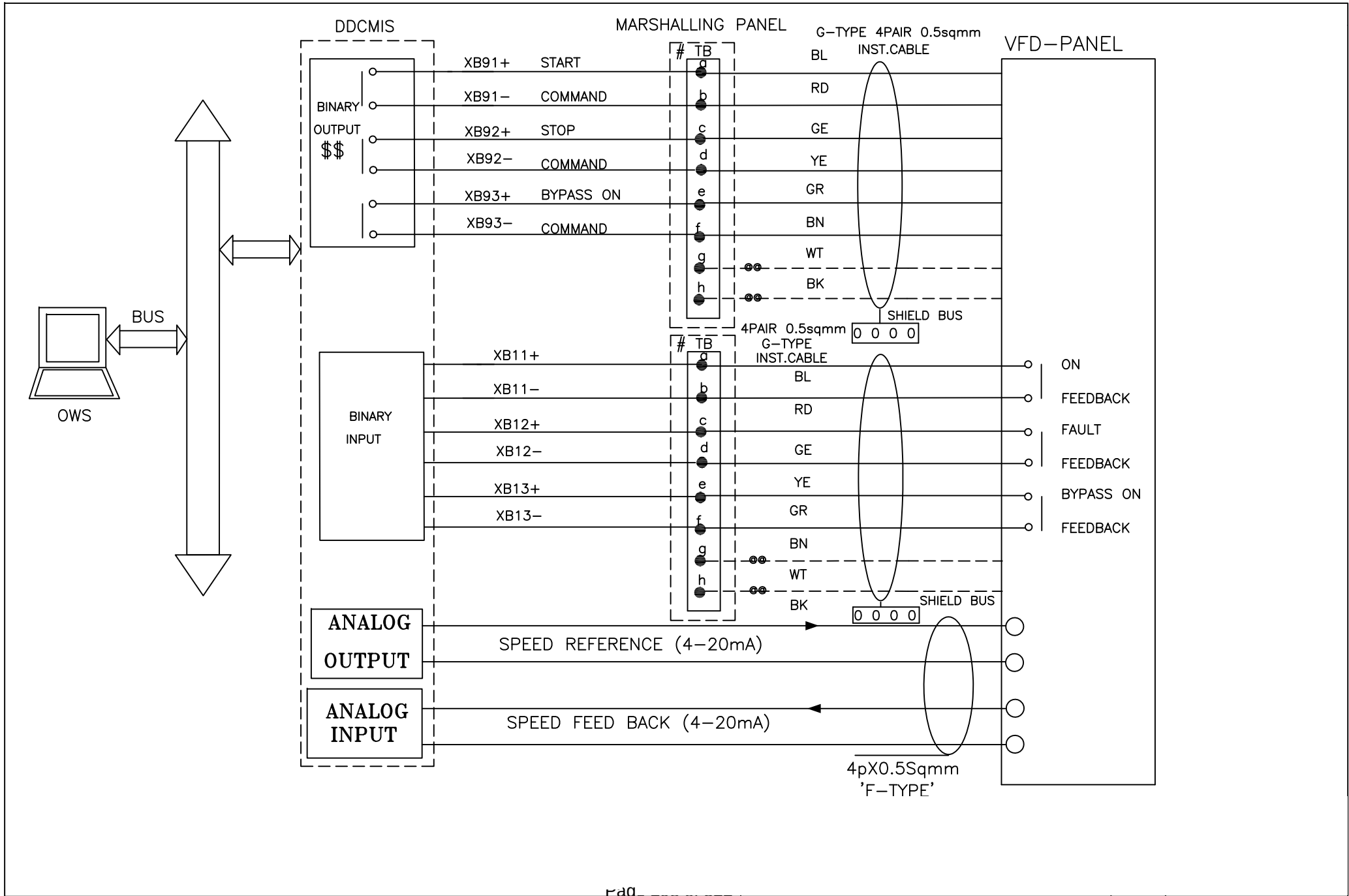


DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)

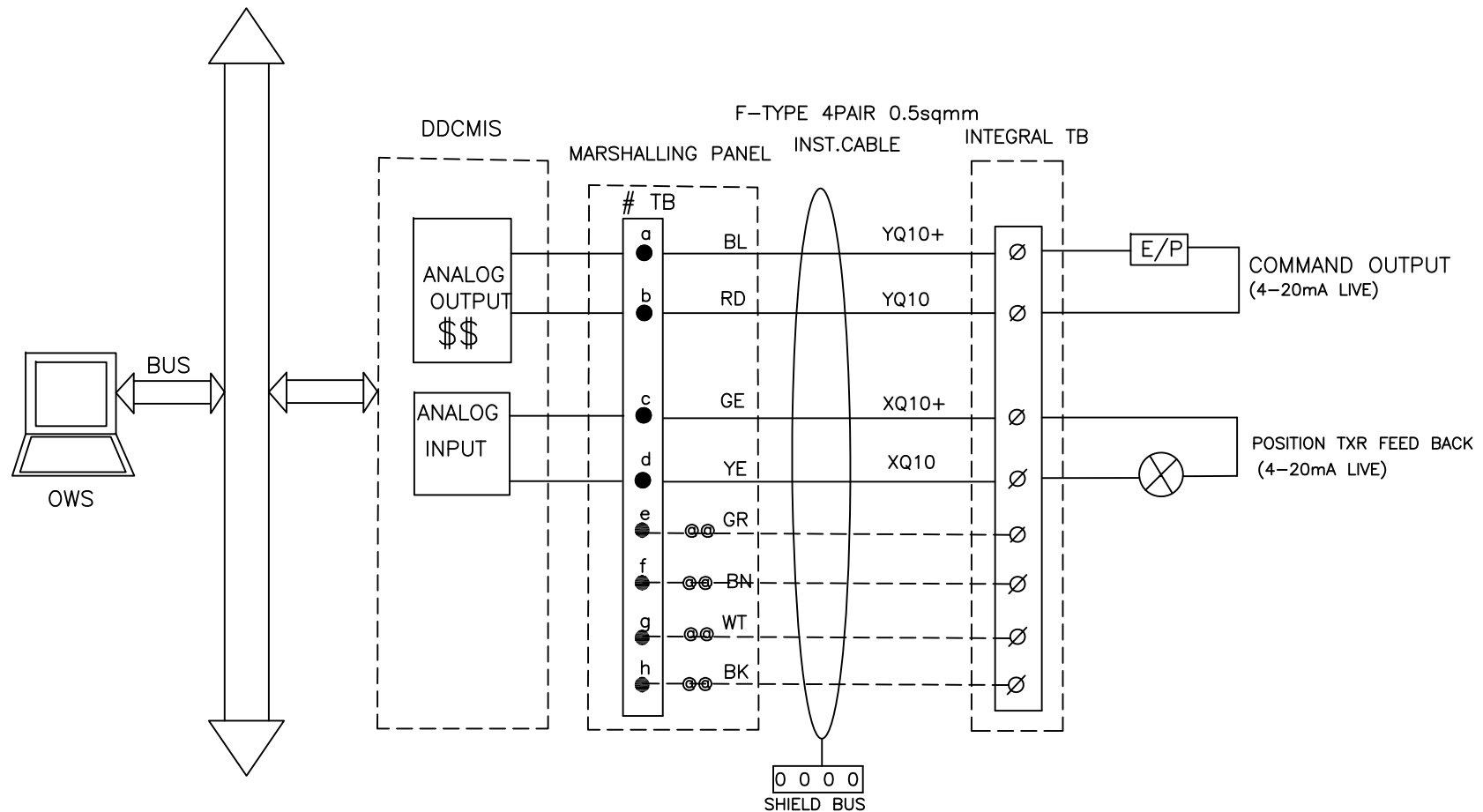




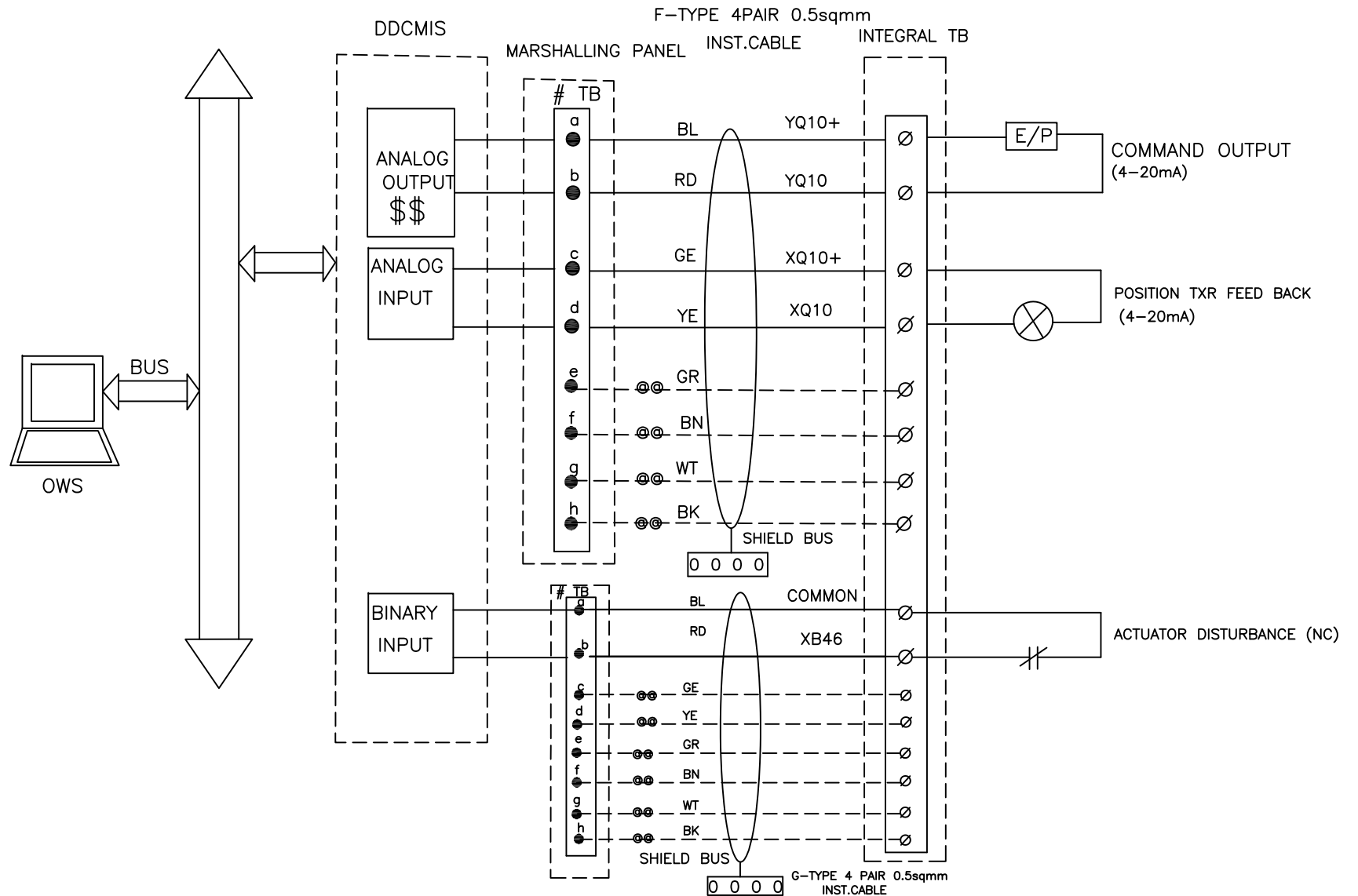
DDCMIS INTERFACE WITH VFD



INTERFACE FOR MODULATING DRIVES - CLCS



INTERFACE FOR MODULATING DRIVES - CLCS-M





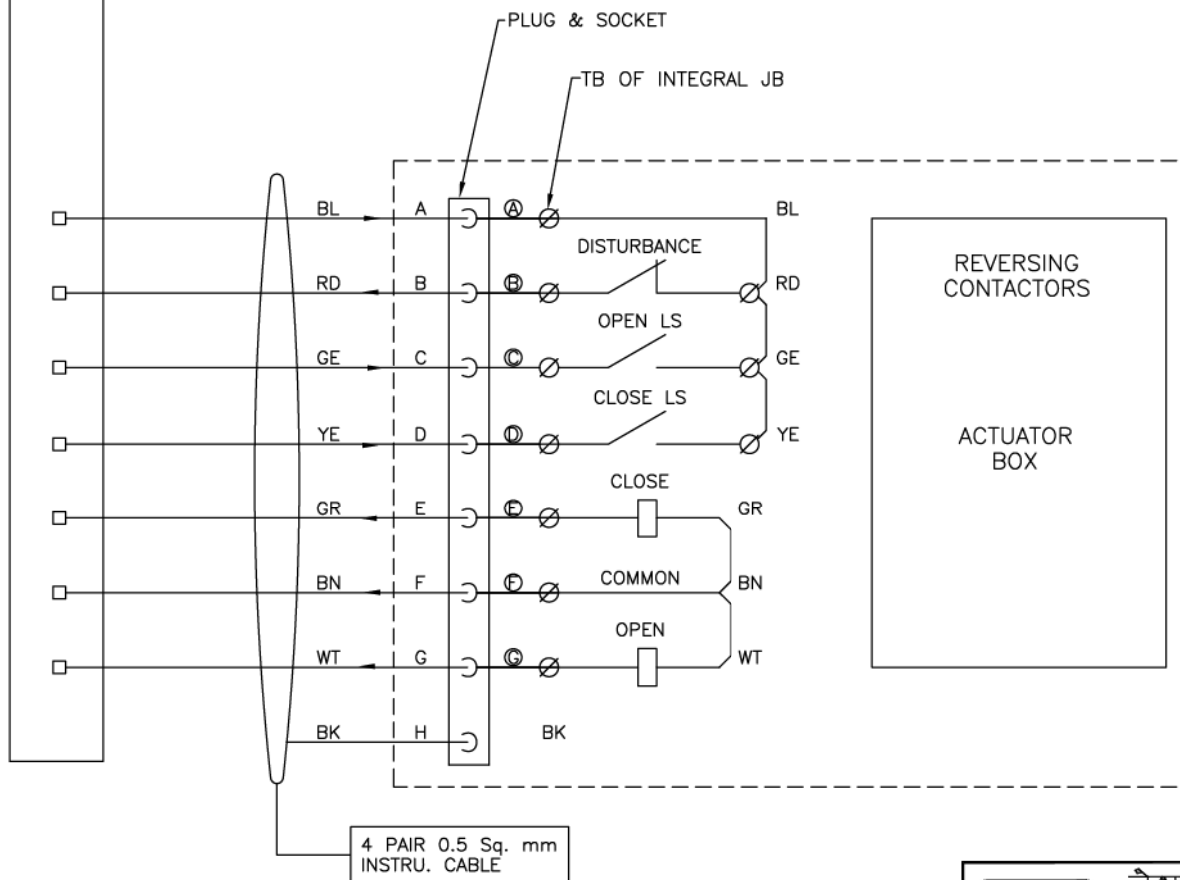
**C&I SPECIFICATION FOR
GYPSUM DEWATERING SYSTEM**

SECTION: C
SUB SECTION: C&I

**DRIVE & INSTRUMENT INTERFACE
DIAGRAM**

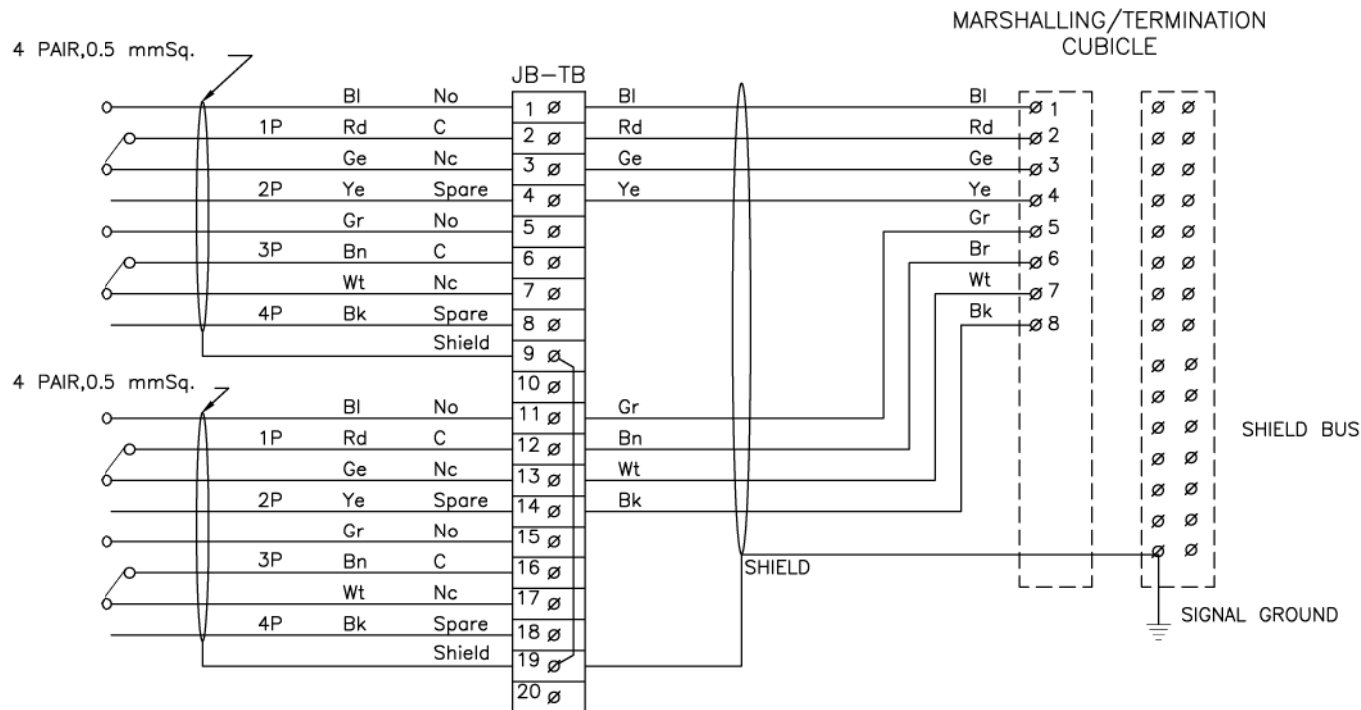
|

TERMINATION AT
CONTROL SYSTEM END



FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC नैशनल थर्मल पावर कारपोरेशन लिमिटेड <i>National Thermal Power Corporation Ltd.</i> (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION			
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF ACTUATORS	
SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-063	D

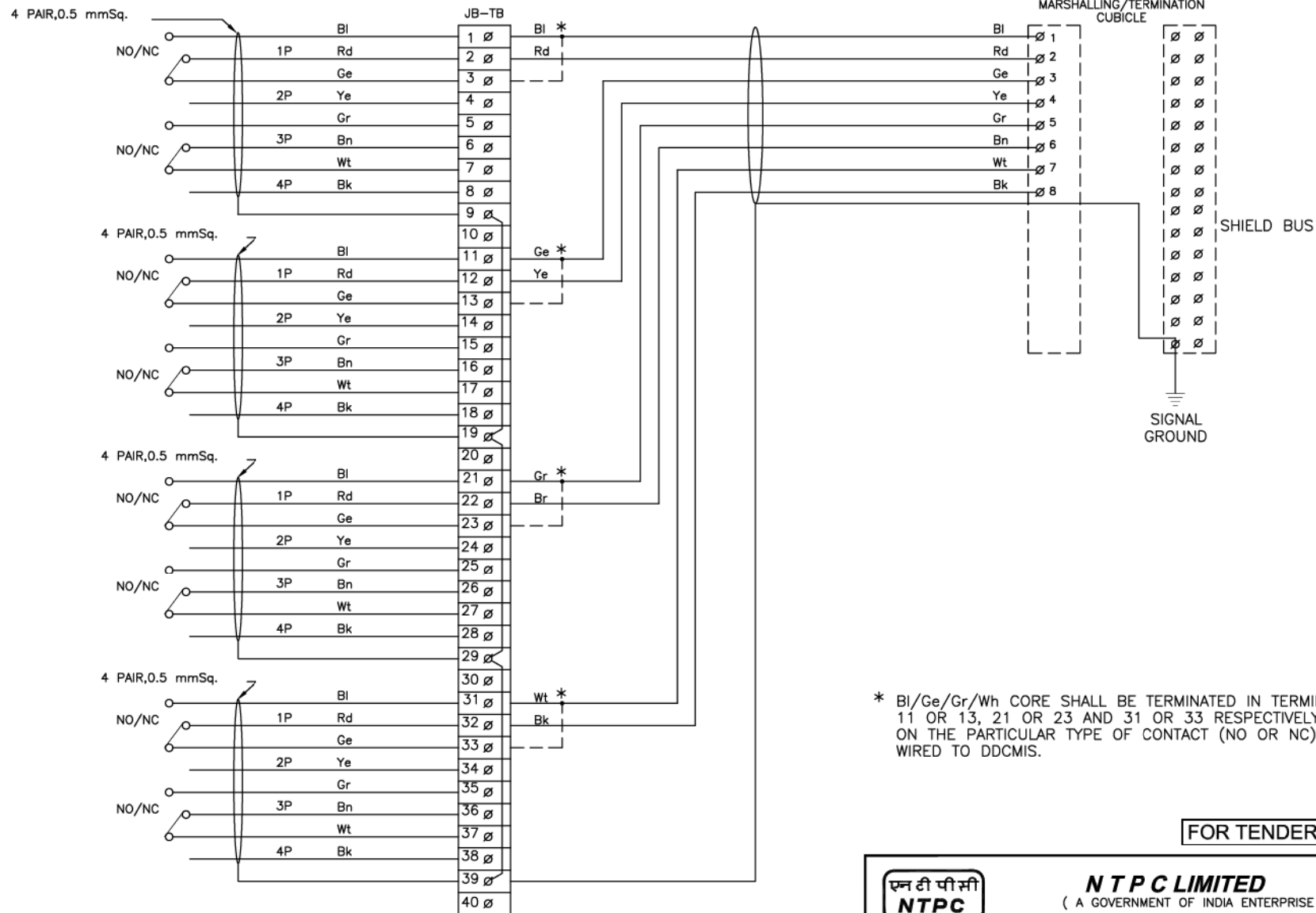


FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

												PROJECT TYPICAL THERMAL POWER PROJECT			
												TITLE INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS			
A	FIRST ISSUE										21.08.12				
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE	SIZE A3	SCALE NTS	DRG. NO. 0000-999-POI-A-065	REV. NO. A
		Page 304 of 522 CLEARING BY									SH 01 OF 15				

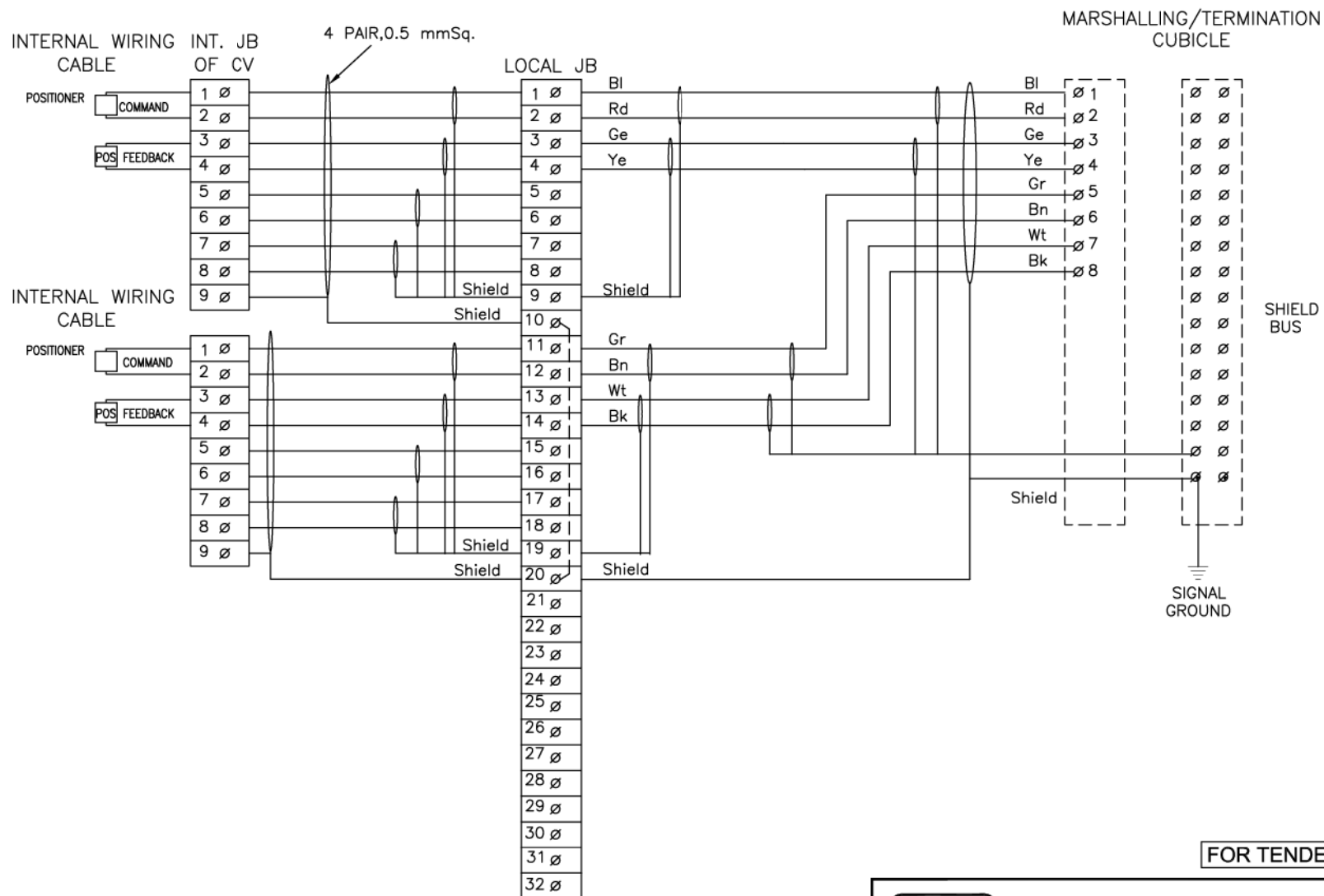


FOR TENDER PURPOSE ONLY



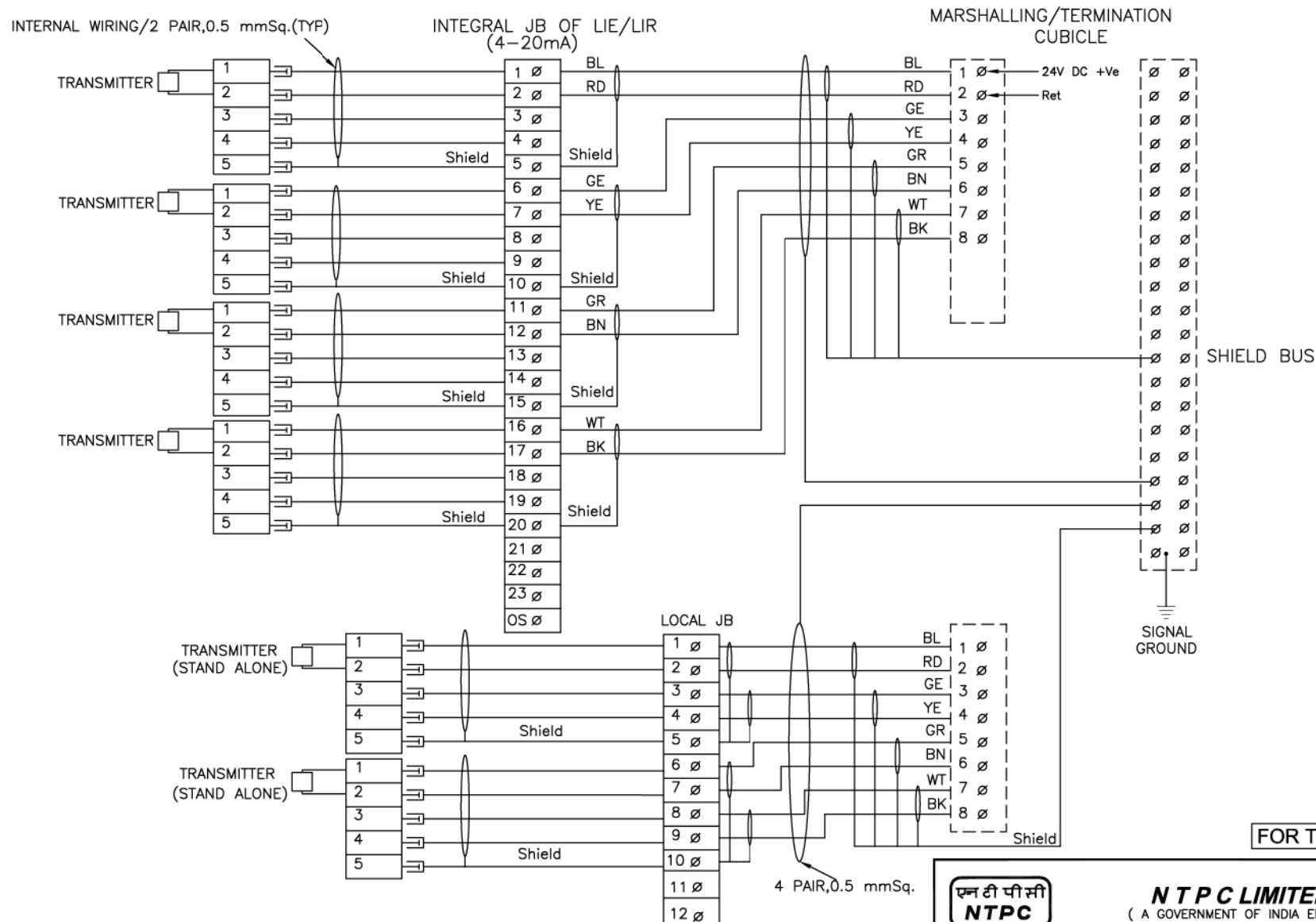
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT		
TITLE		INTERFACING OF FIELD INSTRUMENTS SWITCH TERMINATION DETAILS NO/NC		
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.
A	FIRST ISSUE			
SIZE	SCALE	DRG. NO.	REV. NO.	
A3	NTS	0000-999-POI-A-065	A	



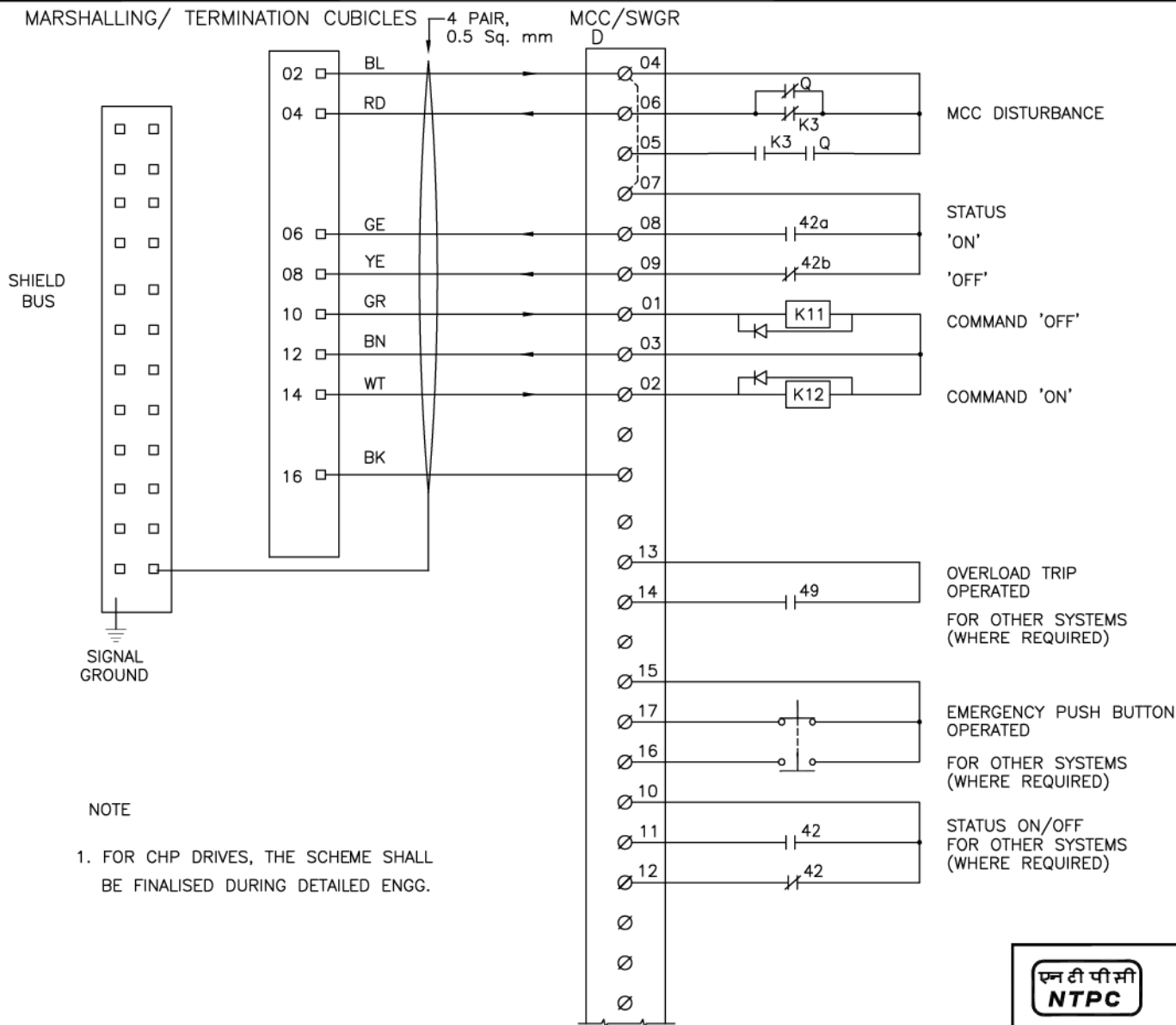
FOR TENDER PURPOSE ONLY

 NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION			
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS CONTROL VALVE	
REV.NO.	DESCRIPTION	DRAWN	DESIGN
A	FIRST ISSUE	21.08.12	
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065	A



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		NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS 4-20mA	
REV.NO.	DESCRIPTION	SIZE	SCALE
		A3	NTS
		DRG. NO.	REV. NO.
		0000-999-POI-A-065	B



NOTE

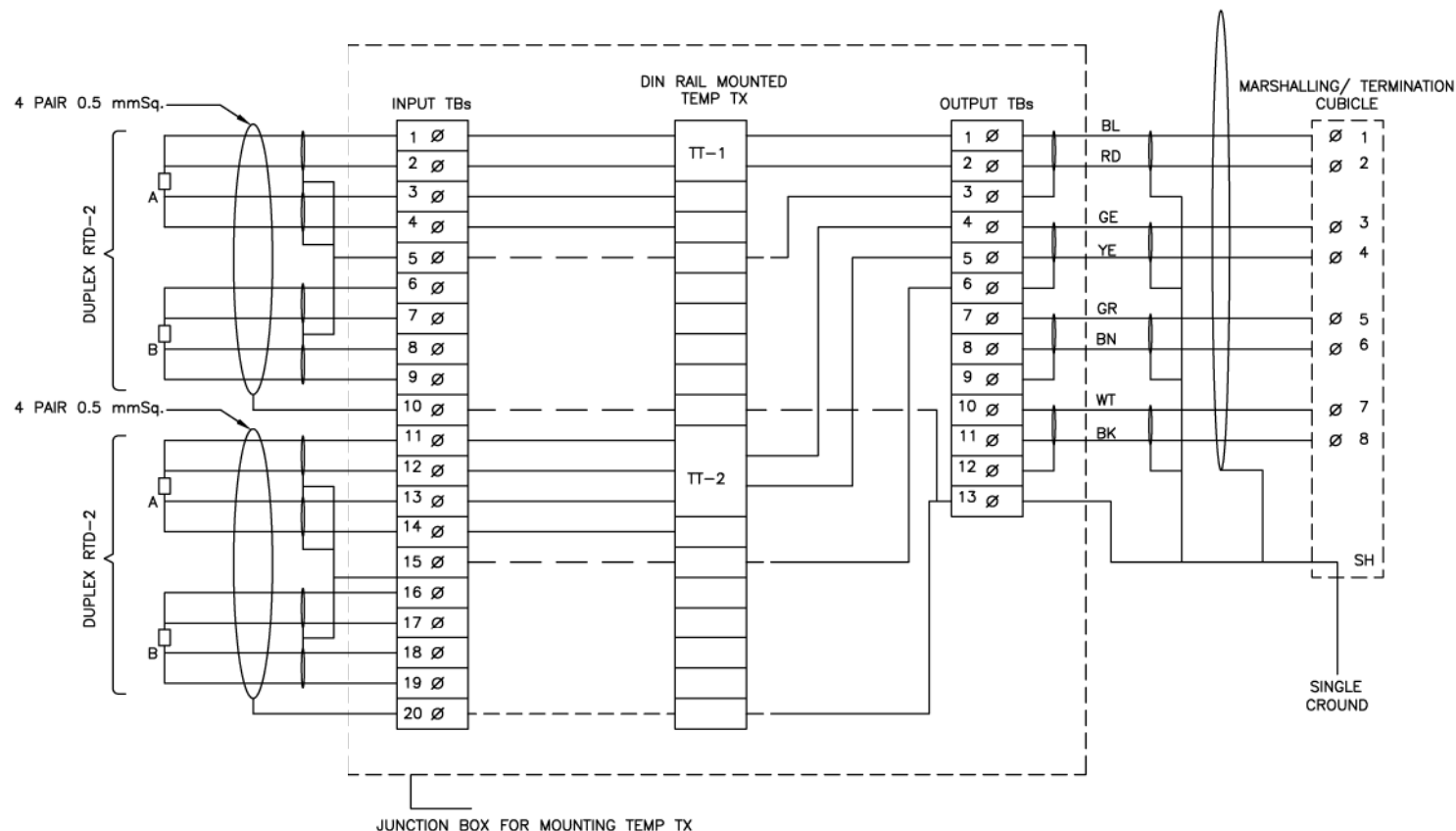
1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

												PROJECT TYPICAL THERMAL POWER PROJECT			
												TITLE INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (LT MOTORS)			
A	FIRST ISSUE										21.08.12				
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE	SIZE A3	SCALE NTS	DRG. NO. 0000-999-POI-A-065	REV. NO. A
					Page 308 of 522									SH 05 OF 15	



- NOTE :- 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.
- 2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.
- 3) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENTS OF RTD SHALL BE CONNECTED TO TT THROUGH INPUT TBs.

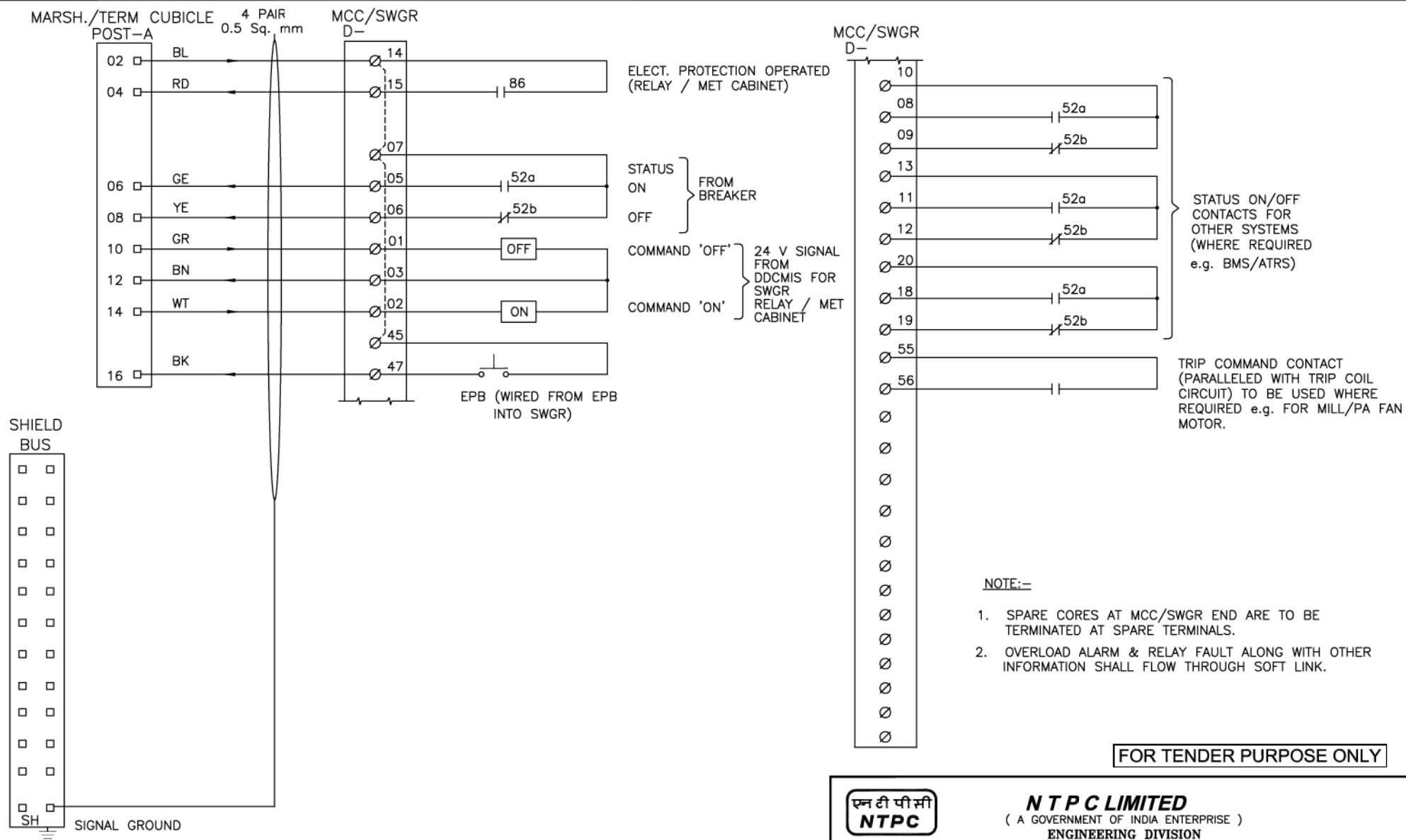
FOR TENDER PURPOSE ONLY



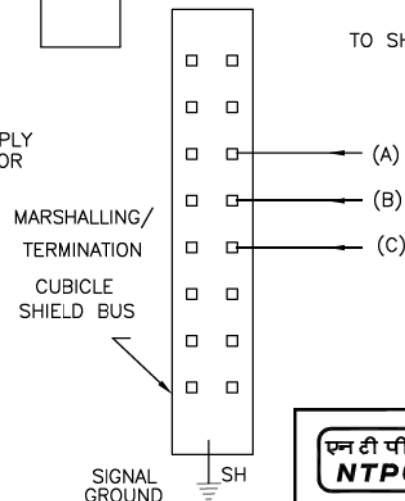
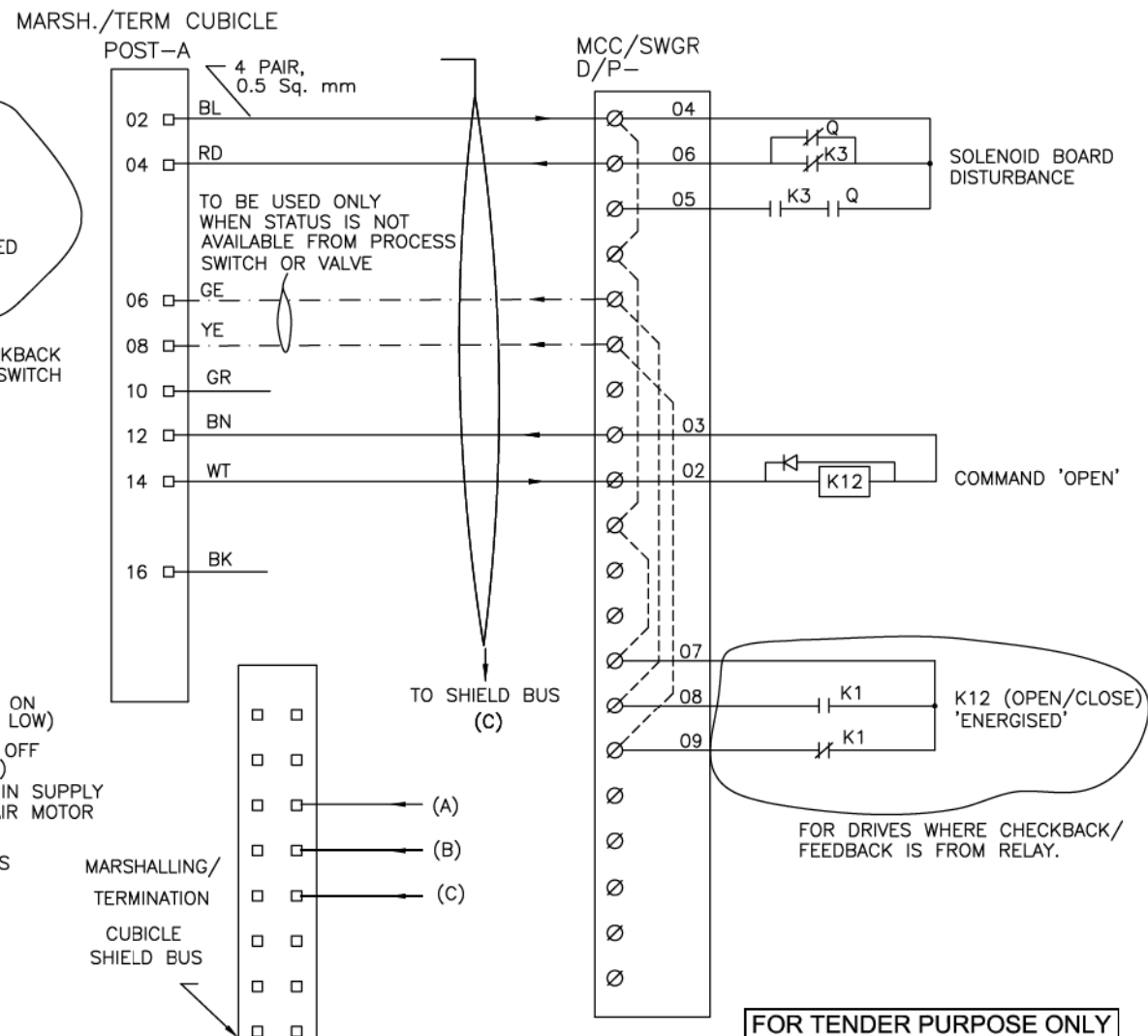
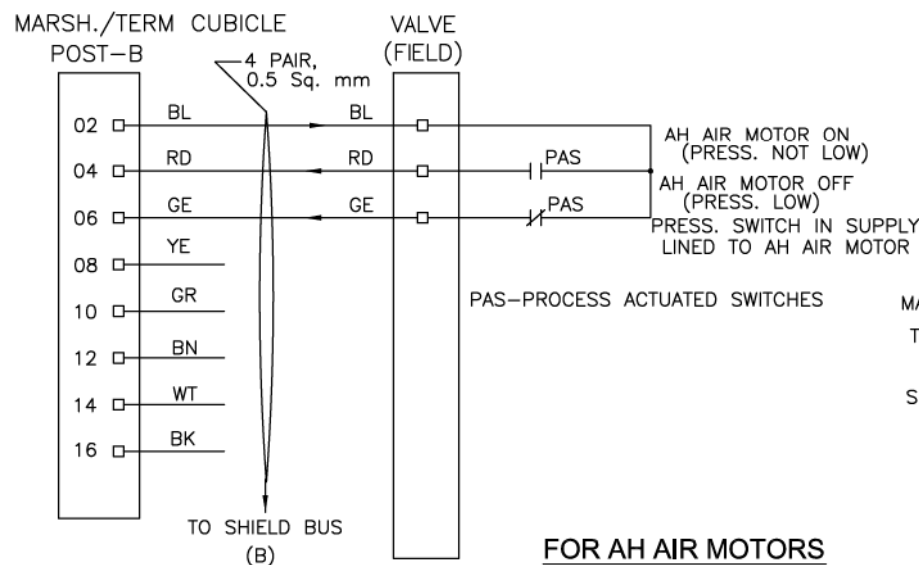
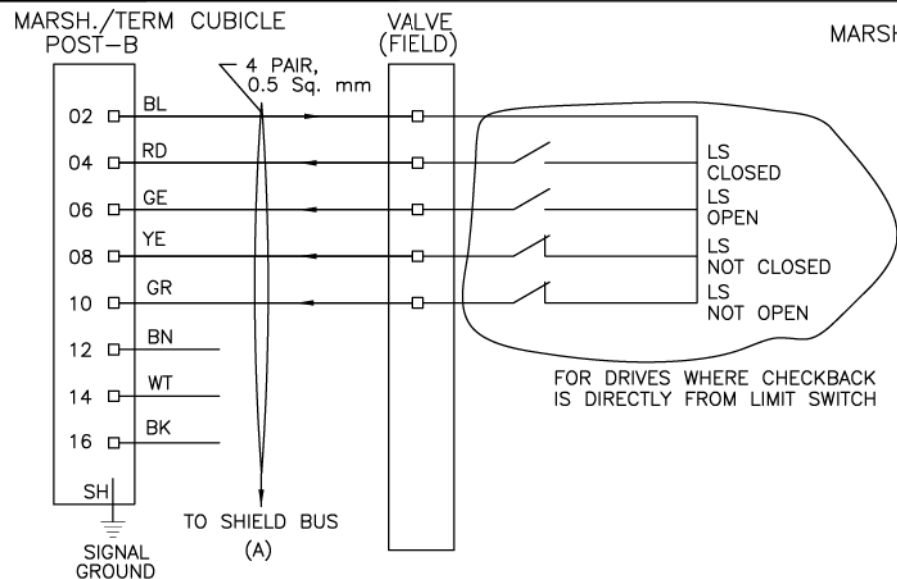
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBs	
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065	A

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE	MA									21.08.12



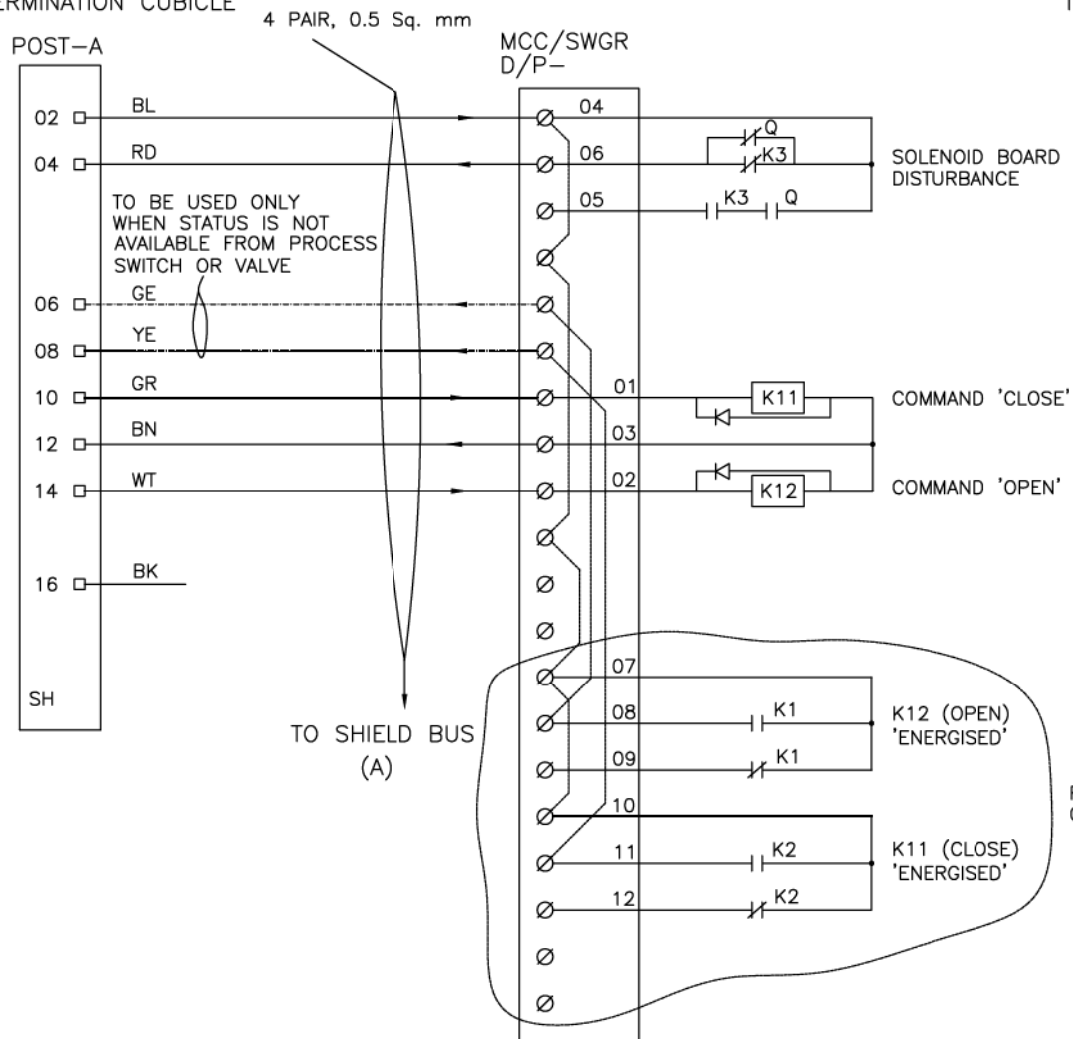
												PROJECT TYPICAL THERMAL POWER PROJECT			
												TITLE INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (HT MOTORS)			
A	FIRST ISSUE										21.08.12				
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE	SIZE A3	SCALE NTS	DRG. NO. 0000-999-POI-A-065	REV. NO. B
						Page 310 of 522									



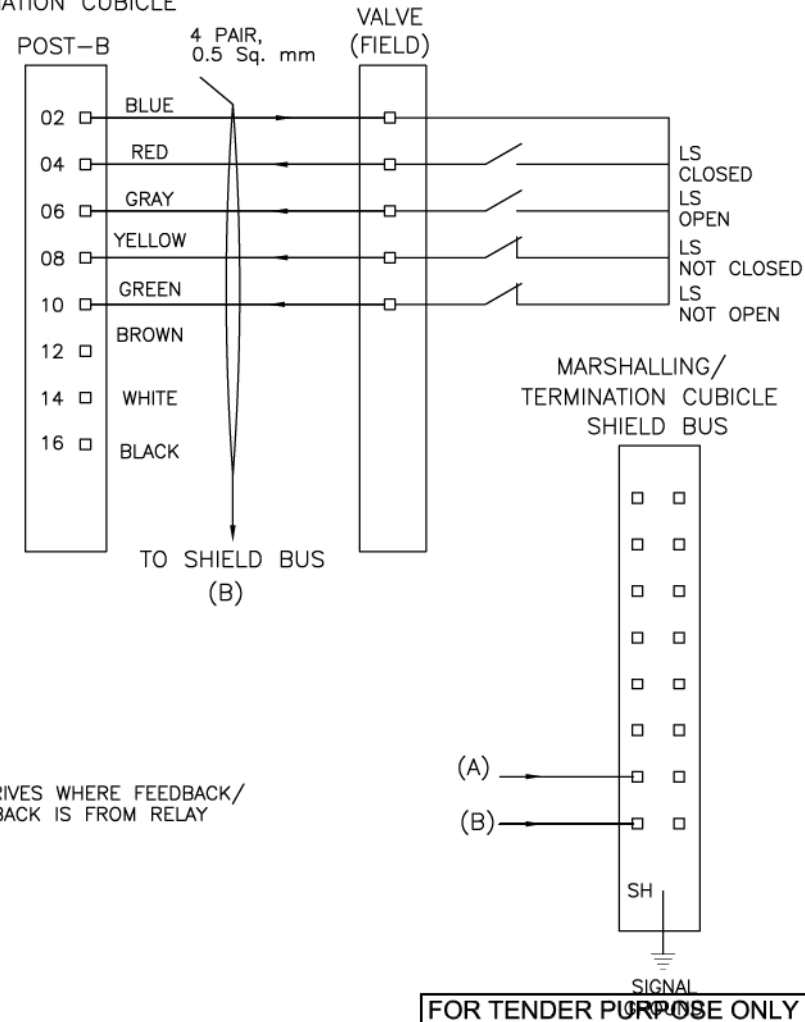
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT			
TITLE		INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (SINGLE COIL SOLENOID)			
SIZE	SCALE	DRG. NO.		REV. NO.	
A3	NTS	0000-999-POI-A-065		A	
				SH 08 OF 15	

MARSHALLING/
TERMINATION CUBICLE

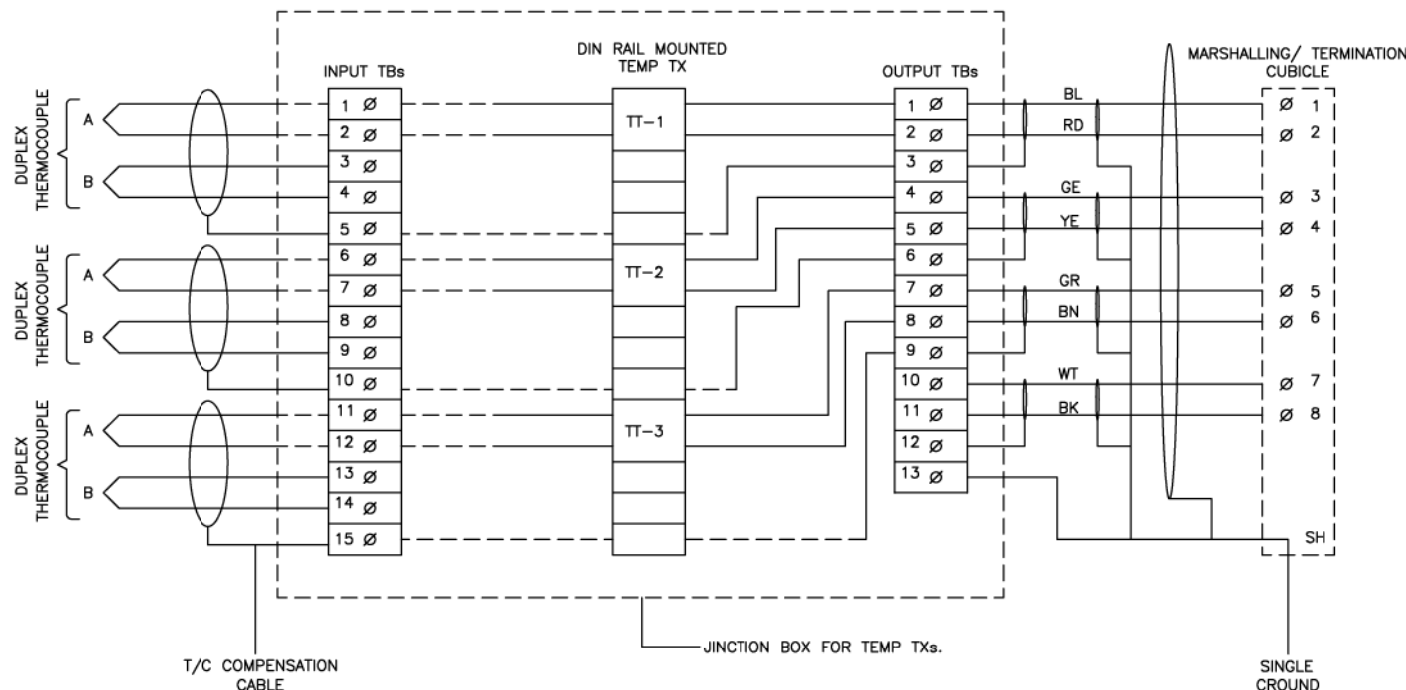


MARSHALLING/
TERMINATION CUBICLE



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT		
TITLE		INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS/PLC WITH MCC/SWGR/ACTUATOR (DOUBLE COIL SOLENOIDS)		
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.
A	FIRST ISSUE	MA	MA	MA
SIZE	SCALE	DRG. NO.	REV. NO.	
A3	NTS	0000-999-POI-A-065	A	



- NOTE :-
- 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.
 - 2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.
 - 3) AFTER GLADDING OF T/C CABLES ON JB. THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND THE CABLE PAIR OF SECOND ELEMENT SHALL BE WIRED TO INPUT TBs FOR FUTURE USE.
 - 4) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN RAIL MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENT OF T/C SHALL BE CONNECTED DIRECTLY TO TT WITHOUT INPUT TBs. HOWEVER 5 NOS OF INPUTS TBs ARE TO PROVIDED FOR EACH T/C FOR FUTURE USE.

FOR TENDER PURPOSE ONLY



NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs	
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065	B

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	CABLING OF 2ND RTD CHANGED TO MATCH COLOR CODE										21.08.12
A	FIRST ISSUE										29.04.06



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

SECTION: C
SUB SECTION: C&I

**QUALITY ASSURANCE FOR
INSTRUMENTS & LCP AND TYPE TEST
REQUIREMENTS**

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION												
MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)													
TESTS													
ITEMS		Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®			
1. PR Gauge (IS-3624)		Y	Y	Y	Y	Y							
2. Temp. Gauge (BS-5235)		Y	Y	Y	Y	Y							
3. Pr./D.P.Switch(BS-6134)		Y	Y	Y	Y	Y	Y						
4. Electronic Transmitter(IEC-60770)		Y	Y	Y	Y	Y	Y						
5. Temp. Switch		Y	Y	Y	Y	Y	Y						
6. Recorder(IS-9319/ANSI C-39.4)		Y	Y	Y	Y	Y	Y						
7. Vertical indicators		Y	Y	Y	Y		Y						
8. Digital Indicators		Y	Y	Y	Y		Y						
9. Integrators		Y	Y	Y	Y								
10. Electrical Metering Instrument (IS-1248)		Y	Y	Y	Y	Y	Y						
11. Transducer (IEC-688)		Y	Y	Y	Y	Y	Y						
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)		Y	Y	Y	Y	Y	Y						
13. RTD(IEC-751)		Y	Y	Y	Y	Y	Y						
14. Thermowell		Y		Y				Y	Y	Y			
R-Routine Test A- Acceptance Test Y – Test applicable													
: Note: 1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization													
2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.													
LOT-IA PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE				TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2				SUB-SECTION-V-QC1 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)				PAGE 1 OF 2	

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)									
TESTS									
ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard (R)	Insulation Resistance (R)	IBR Certification (if applicable) (R)	Hydro Test (R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch (BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter (IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder (IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable									
: Note: 1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.									

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)												
ITEMS	TESTS											
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**			Y	Y**	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test A- Acceptance Test Y – Test applicable												
Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.												

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION														एनटीपीसी NTPC		
Process, Connection & piping FOR C&I SYSTEMS																	
TESTS																	
ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening, flaring, hydrotest, hardness check as per ASTM standard	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessibility of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydraulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y*		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y
*-applicable for painted junction boxes.																	
Note: R-Routine Test																	

INSTRUMENTATION CABLE

TESTS ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheath/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidish chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)

- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM

ITEMS	TESTS													
	Visual ®	GA, BOM, Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element ,	Mimic ®	Test as per IEC 1131 ® *
1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
2. Annunciation/ Control/ PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y
3.Smoke Detectors (UL-268,EN-54 PT-7), Heat Detectors(UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)														Y
Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents. *Applicable for PLC - Y - Test Applicable , ® - Routine Test (A) - Acceptance Test														

CONTROL VALVE ACTUATORS AND ACCESSORIES.

ITEMS	TESTS													
	Make,model, tag (r)	Dimension®	Surface finish®	Heat treatment®	Material test certificates®	Ibr certificates®	Hydraulic test®	Ut/radiography for >900 lb rating®	Mpi/dp®	Pressure resistance®	Seat leakage®	Timing open/close®	Linearity/hysteresis®	Functional test, review for make and tc of accessories®
CONTROL VALVE AND ACTUATOR														
Overall	Y	Y	Y			Y	Y				Y	Y	Y	Y
Body		Y	Y	Y	Y			Y	Y	Y				
Bonnet		Y	Y	Y	Y									
Trim		Y			Y			Y*						
Pneumatic actuator	Y	Y								Y				
Electro pneumatic positioner	Y													Y
R- ROUTINE TEST A - ACCEPTANCE TEST Y - TEST APPLICABLE														
Y* - UT ON SPINDLE DIA >= 40 MM.														
NOTE : 1) Detailed procedure of environmental stress screening test shall be as per quality assurance programme general technical conditions														
2) This is an indicative list of tests/checks. the manufacture is to furnish a detailed quality plan indicating his practice & procedure along with relevant supporting documents during QP finalisation for all item.														

VFD PANEL

Attributes Characteristics																		
Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant				
Sheet Steel (IS-513)		Y	Y	Y														
Aluminum / Copper Bus-bar (IS-5082/IS-613/IS-1987)	Y	Y	Y	Y														
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y														
Control / Selector Switch (IS-6875)					Y	Y	Y											
Contactors/ MCB (IS-13947)					Y	Y	Y											
O/L Protection relays (IS-3231)					Y		Y											
C.T /V.T/ Indicating Meter (IS-2705/3156/1248)					Y	Y	Y											
Fuse/ Fuse carrier (IS-13703)					Y	Y	Y											
Terminals/lugs/pvc wires (IS-13947/IS-694)	Y			Y	Y	Y	Y											
Timers (IS-3231)					Y	Y	Y											
Push Button/ Lamp/ (IS-6875)					Y	Y	Y											
Control Transformer (IS-12021)					Y	Y	Y											
Mimic, Annunciater					Y		Y											
GASKET (IS-11149)		Y	Y	Y	Y		Y											
Fabrication								Y										
Pretreatment & Painting									Y	Y								
VFD panel										Y	Y	Y	Y	Y				

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics													
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS 9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.													
® - Routine Test (A) - Acceptance Test Y - Test applicable													



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME	IIB		
									SECTION	D		
									REV. NO.	01	DATE: 22-02-2008	
									SHEET	3	OF	7
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---	
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL					STD QUALITY PLAN NO.: PE-QP-999-145-I056					
							VOLUME		IIB			
							SECTION		D			
							REV. NO.		01		DATE: 22-02-2008	
							SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics			\$	P - Agency Performing the Test.	1 - BHEL
MA - Major characteristics				W - Agency Witnessing the Test.	2 - Vendor
MI - Minor characteristics				V - Agency Verifying the Test.	3 - Sub-vendor

बी एच ई एल PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		7		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1		
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1		

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics			^{\$} P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.			1 - BHEL 2 - Vendor 3 - Sub-vendor		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	TYPE TEST REQUIREMENTS 1.00.00 TYPE TEST REQUIREMENTS 1.01.00 General Requirements 1.01.01 The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening but not more than five (5) year back. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account. 1.01.02 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer. 1.01.03 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 1 OF 7	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.			
1.01.05	The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.			
2.00.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS			
2.01.00	The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems Analyzer instruments, various PLCs etc. shall be as indicated below: i) Surge Protections for Solid State Equipments/ Systems All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted alongwith the proposal. As an alternative to above, suitable class of IEC-60255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test. ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 50082-2 or equivalent.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 2 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	vii) Electromagnetic immunity as per EN 61131-2 or equivalent. Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.			
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 3 OF 7

3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS

Sl No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes	
2	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes	
3	INSTRUMENTATION CABLES TWISTED & SHIELDED			No	Yes	
4	Pressure gauge	Degree of protection test	IS-2147	No	No	
		Temp interference test	IS -3624	No	No	
5	Temperature gauge	Degree of protection test	IS-2147	No	No	
6	Pressure & DP switch	Degree of protection test	IS-2147	No	No	
		As per standard (col 4)	BS 6134	No	No	
7	Level switch	Degree of protection test	IS-2147	No	No	
8	Control valves	CV Test	ISA 75.02	No	Yes	
9	Flow Nozzles & Orifice plate	Calibration	ASME PTC , BS 1042	No	Yes	
10	PLCs	All tests as per IEC-1131	IEC-601131	No	Yes	

SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
11	Junction Box	Degree of protection test	IS-13947	No	Yes	
12	Battery charger (Not required for inbuilt chargers)	Degree of protection test	IS-13947	No	No	
		Short circuit current capability	IEC-60146-2	No	Yes	
		Temp rise test without redundant fans	Approved procedure, IEC 60146-2	No	Yes	
		SWC test	Approved procedure	No	Yes	
		Burn-in-test	Approved procedure	No	Yes	
		Efficiency	IEC-60146-2,	No	Yes	
		Audible Noise Test	IEC 60146-2	No	Yes	
		Fuse Clearing Capability	Approved procedure	No	Yes	
		Relative harmonic content	Approved procedure	No	Yes	

SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
		ESD immunity test	IEC-61000-4-2-9(1)	No	Yes	
		Radio interference	IEC 60146-2	No	Yes	
		Over Load Test on Inverter & charger	Approved procedure	No	Yes	
		Restart Test	IEC 60146-2	No	Yes	
		Output voltage tolerance	Approved	No	Yes	
		Output voltage Harmonic content	Approved procedure	No	Yes	
		Insulation test	IEC 60146	No	Yes	
		Load Tests	Approved procedure	No	Yes	
		Preliminary light load test	IEC 60146	No	Yes	
		Current division / Voltage division	IEC 60146-2	No	Yes	
13	Battery	As per standard (col 4)	IEC –623 / IS 10918 for Ni-Cd IS-1652 for Plante Lead Acid	No	Yes	
14	Voltage stabilizers	Over Load Test	Approved procedure	No	Yes	

SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
		Temp rise test without redundant fans	Approved procedure	No	Yes	



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

SECTION: C
SUB SECTION: C&I

MANDATORY SPARES

Refer Annexure-II of Sub Section-D of Section-I for the list of mandatory spares pertaining to C&I scope.



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

SECTION: C
SUB SECTION: C&I

SUB VENDOR LIST

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PACKAGE WISE REGISTERED SUPPLIER LIST AS ON 2/3/2020

SI No	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
1	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : dario.torluccio@valvitalia.com	Works-1->Mr. Salvatore Ruggeri Via Tortona 69,Rivanazzano (Pavia) -- Italy Phone- +39-03839459875 FAX : Pincode : 27055 Email : dario.torluccio@valvitalia.com; diego.poletti@valvitalia.com; sales@hbassociates.com
2	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcinpvt@bol.net.in	Works-1->SAVITH KUMAR PLOT NO. A-250, OPP.POLICE STATION,WAGLE INDUSTRIAL ESTATE, THANE -THANE- MAHARASHTRA INDIA Phone- 022-66060942 FAX : 022-25820801 Pincode : 400 604 Email : rkadmin@rkcipl.co.in
3	CONTROL VALVE	Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda -Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com
4	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : iatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai- TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com
5	CONTROL VALVE	Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai- TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in
6	CONTROL VALVE	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, - Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafa-india.com
7	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune- MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com
8	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALAKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, - PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mrj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com;remith@ilpgt.com
9	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : jetmal.gour@koso.co.in	Works-1->P.J.ASHOK KUMAR/SEEMA ANAND Control Valve Division, H-33&34, MIDC, Ambad, -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in;enquiry@koso.co.in Works-2->+P.J.ASHOK KUMAR/SEEMA ANAND J-1,MIDC,Ambad -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in;enquiry@koso.co.in

10	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net	Works-1-> Others D 281, MIDC Ranjangaon -Pune-MAHARASHTRA India Phone- 02067246600,8554997963 FAX : Pincode : 412220 Email : sales@samsoncontrols.net
11	CONTROL VALVE	KSB MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : hiiu_simon@ksb.com	Works-1->Mr.Biju Simon/Mr.Jose Paul Meladoor, Annamanada, -Thrissur-KERALA INDIA Phone- 9447555500 FAX : 91 480 2890952 Pincode : 680741 Email : jose_paul@ksb.com
12	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou Phone- 008618012776062 Pincode : 215143 Email : jeanielei@delan-valve.com	Works-1->Mr. Zong Xin CEO No 566 Fangqiao Road Caohu Industrial Park,Xiangcheng E. Z. -Suzhou-Foreign Country CHINA Phone- 008618012776062 FAX : Pincode : 215143 Email : jeanielei@delan-valve.com
13	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	Mr. Winfried Dremhel Schulenburgerlandstrasse 261, Hannover Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; wvonel@pruss.de	Works-1->Mr. Winfried Dremhel CEO Schulenburgerlandstrasse 261, -Hannover-GERMANY Phone- +49-511279260 FAX : Pincode : 30419 Email : dremhel@pruss.de
14	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : npressure@vsnl.com	
15	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh_parmar@ashcroftindia.com
16	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com
17	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	
18	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de	
19	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit_patel@ashcroftindia.com	
20	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com
21	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mkta@indfos.com	

22	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KA NNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
23	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba, Sonarpur Station Road, P.O. - Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
24	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net
25	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :
26	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.co m	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM, -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com
27	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral, Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
28	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI- GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
29	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb, Yeshwanthpur - BANGALORE-KARNATAKA INDIA Phone- 080- 23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhabazra@hgurusouth.com
30	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6, Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel- MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
31	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi- GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, hkanadia@nesstech.co.in
32	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction, Near Kalsekar College kausa, mumbra, Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409, 9892230623 FAX : Pincode : 400612 Email : sdbnl@vsnl.com

33	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb, Yeshwanthpur - BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhabazra@hgurusouth.com
34	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6, Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel- MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
35	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :
36	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	Works-1->Mrs Saanvi Naik BICHOLIM, - BICHOLIM-GOA INDIA Phone- 9595855152 FAX : Pincode : 403 529 Email : saanvi.naik@thermostatic.in
37	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784, 22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba, Sonarpur Station Road, P.O. - Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
38	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2, I.D.A. NACHARAM, -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com
39	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
40	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral, Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
41	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI- GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
42	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
43	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B, Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand.com

44	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
45	FLOW ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocci VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	Works-1->Mrs. Enrica Bazzocchi VIA DELLE INDUSTRIE, 36, -CREMONA- Italy Phone- 39037221574 FAX : 39037228318 Pincode : 26100 Email : sales@tmtecnomatic.com
46	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHÚNDRA BANSODE Sr no.54, Plot No.110,Swami ViVekanand Industrial Est.HADAPSAR -PUNE- MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email : marketing@starmech.net
47	FLOW ELEMENT	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	
48	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village- Dudhola, Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wilka.com	
49	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	Works-1->Mr. A.D.Solomon J-14, MIDC, TARAPORE, BOISER STN., -THANE- MAHARASHTRA India Phone- FAX : Pincode : Email : trivtech@vsnl.com
50	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi- GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkanadia@nesstech.co.in
51	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema, Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@niconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Survey No. 250A/B, Post-Mangaon, Tal.- Kudal, Dist.- Sindhudurg, --MAHARASHTRA India Phone- 09322664709 FAX : 022-24455026 Pincode : 416519 Email : ramk@niconindia.com
52	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	Works-1->Mr. S.D Deval B-188A ROAD NO.5 ,M.I.A -UDAIPUR-RAJASTHAN INDIA Phone- 9352501530 FAX : 0294-3057750 Pincode : 313003 Email : deval@tempsens.com
53	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI- GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
54	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com

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56	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamoli Taluka Panvel- MAHARASHTRA INDIA Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
57	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer- RAJASTHAN INDIA Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : raieev.gunta@tipl.com
58	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdhnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdhnl@vsnl.com
59	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080- 41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE- KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com
60	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer- RAJASTHAN INDIA Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : raieev.gunta@tipl.com
61	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
62	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com
63	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S- 18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
64	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R- 628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA INDIA Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com
65	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	Works-1-> M-171 to 173, MIDC, Waluj, - Aurangabad-MAHARASHTRA INDIA Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetter.endress.com
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67	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net. in	
68	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI- MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :
69	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : acruz@miinet.com
70	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022- 66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com
71	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. S L Sadani Others 104 - 115,Electronic Complex -Indore-MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols com
72	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE- MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com
73	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
74	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764- 233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	
75	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRAMAN/MR.B.KA NNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
76	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044- 26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044- 26248849 Pincode : 600050 Email : cservice@switzerinstrument.com
77	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com

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82	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
83	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA -HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com
84	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	
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88	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com

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90	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120- 4352940 Pincode : 201301 Email : naveensingh@vsnl.com
91	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W- 167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
92	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022- 40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
93	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co- op.Estate Ltd,Nagargaon, -Lonavla- MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
94	ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE- III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@iefflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA -HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040- 23096401 Pincode : 500055 Email : sales@iefflowmeters.com
95	ROTAMETER	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	Works-1->MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Complex,20/3, Mathura Road -FARIDABAD- HARYANA INDIA Phone- 0129-4069661, FAX : 0129-4069663 Pincode : 121005 Email : tkjana@flowstar.co.in
96	ROTAMETER	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaIndia@gmail.com	Works-1-> Others Mohanjee Sundarjee Road, Raghunath Nagar, Thane -Mumbai- MAHARASHTRA INDIA Phone- FAX : Pincode : 400604 Email :
97	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	Works-1->Mr S. M. Alawani/Mr V. V. Deshpande J-501, M.I.D.C. Pimpri, -PUNE- MAHARASHTRA INDIA Phone- 9325751732 FAX : 020-30681731 Pincode : 411018 Email : works@eurekaflow.com
98	ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdhnl@vsnl.com	Works-1->Scientific Centre, S.No. 65, Hissa No. 7,By-Pass Junction, Kausa, -Mumbai- MAHARASHTRA INDIA Phone- 9892230623, FAX : 022-25491408/9 Pincode : 400 612, Email : sales@scientificdevices.com

99	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
100	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com
101	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbnl@vsnl.com
102	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	
103	LEVEL SWITCH-CAPACITANCE TYPE	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	Works-1->MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Complex,20/3, Mathura Road -FARIDABAD-HARYANA INDIA Phone- 0129-4069661, FAX : 0129-4069663 Pincode : 121005 Email : tkjana@flowstar.co.in
104	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
105	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI- GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
106	LEVEL SWITCH-CONDUCTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com	Works-1->Mr. Ashwin R Palshikar/Mr. Navin Bodse 131 PALSHIKAR COLONY, -INDORE-MADHYA PRADESH INDIA Phone- 9754261005 FAX : 0731-2475475 Pincode : 452004 Email : sales@sapcon.in
107	LEVEL SWITCH-CONDUCTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	Works-1-> 38G, PICNIC GARDEN ROAD, - KOLKATA-WEST BENGAL INDIA Phone- FAX : Pincode : Email :
108	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand.com
109	LEVEL SWITCH-CONDUCTIVITY TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com

110	LEVEL SWITCH- CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeen@hitech.in	Works-1->Mr. Jitendra Kumar/Mr. Debasis Dey 82/1, Sarsuna Main Road, -KOLKATA- WEST BENGAL INDIA Phone- 9883994030 FAX : Pincode : 700061 Email : jitendra@hitech.in
111	LEVEL SWITCH- CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com	Works-1->NA -- Phone- FAX : Pincode : Email :
112	LEVEL SWITCH- CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
113	LEVEL SWITCH- CONDUTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com
114	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
115	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net	
116	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com
117	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbnl@vsnl.com
118	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	
119	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	
120	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE- MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in

121	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
122	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
123	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdresh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdresh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com
124	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
125	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
126	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
127	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
128	ULTRASONIC FLOW METERS	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk - Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com
129	ULTRASONIC FLOW METERS	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com	Works-1-> Plot No 4,S.No.17/1-B Kothrud Industrial Estate -Pune-MAHARASHTRA india Phone- 020 25464551 FAX : Pincode : 411038 Email : info@adeptfluidyne.com
130	ULTRASONIC FLOW METERS	FLEXIM Flexible Industriemesstechnik GmbH	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de	Works-1-> Others Boxberger Str. 4, -Berlin-GERMANY Phone- 0049 30 93 66 76 60 FAX : Pincode : 12681 Email : info@flexim.de
131	ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiva@rockwin.com	Works-1->MR Rajiv PRAKASH B-24, Site-IV, Sahibabad Industrial Area, -Ghaziabad-UTTAR PRADESH India Phone- 9810129687 FAX : 01202895450 Pincode : 201010, Email : raiiv@rockwin.com

132	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in	Works-1-> Others M/s Endress & Hauser, Aurangabad, Maharastra -Aurangabad-MAHARASHTRA INDIA Phone- FAX : Pincode : Email : Works-2->+ Others M/s Endress & Hauser, Bhiwandi,Thane -Thane-MAHARASHTRA INDIA Phone- FAX : Pincode : Email :
133	ULTRASONIC FLOW METERS	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com	Works-1->Mr. Marcus Fischer CEO Im Taele 2, Eppingen, -Baden Wuerttemberg,-Foreign Country GERMANY Phone- 0049-726291910 FAX : Pincode : 75031 Email : carolin.schuster@nivus.com
134	FLOW ELEMENT - ORIFICE	MINCO (INDIA) PRIVATE LIMITED	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : nicdelhi@general-gauges.com	Works-1-> D/35,TIVIM INDUSTRIAL ESTATE, KARASWADA,MAPUSA, -Goa-Goa India Phone- 9320197825, FAX : 0832-2257262, Pincode : 403526, Email : santoshkumar@general-gauges.com
135	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaIndia@gmail.com	Works-1-> Others Mohanjee Sundarjee Road, Raghunath Nagar, Thane -Mumbai-MAHARASHTRA INDIA Phone- FAX : Pincode : 400604 Email :
136	FLOW ELEMENT - ORIFICE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbnl@vsnl.com
137	FLOW ELEMENT - ORIFICE	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk - Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com
138	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mraj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com;remith@ilpgt.com
139	FLOW ELEMENT - ORIFICE	HYDROPNEUMATICS PVT. LTD.	Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa Phone- 0832-2360364 Pincode : 403507 Email : aiavrc@hvdronneumatics.co.in	Works-1->Mr. DM Bichu D2/6, Bicholim Industrial Estate, -Bicholim-Goa India Phone- 0832-2360364 FAX : 0832-2360368 Pincode : 403529 Email : aiavrc@hvdronneumatics.co.in
140	FLOW ELEMENT - ORIFICE	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	Works-1->MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Complex,20/3, Mathura Road -FARIDABAD-HARYANA INDIA Phone- 0129-4069661, FAX : 0129-4069663 Pincode : 121005 Email : tkjana@flowstar.co.in
141	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola, Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com	Works-1->Mr. SANJEEV CHAUHAN ,H.B. No.-40 Others Revenue Estate, Village-Dudhola, Tehsil & Distt.-Palwal -Faridabad-Haryana India Phone- 9560742713 FAX : Pincode : 121002 Email : anil.bhati@wika.com
142	FLOW ELEMENT - ORIFICE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Dir D2-49/50, Tivim Industrial Estate,Karaswada - Mapusa-GOA INDIA Phone- 0832-2257059 FAX : 022-24455026 Pincode : 403526 Email : gicflowelement@giconindia.com

143	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHÚNDRA BANSODE Sr no.54, Plot No.110,Swami ViVekanand Industrial Est.HADAPS -PUNE- MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email : marketing@starmech.net
144	FLOW ELEMENT - ORIFICE	CHEMTROLS INDUSTRIES PVT. LTD.	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com	Works-2->+Works -II :M/s Chemtrols Samil (I) Pvt. Ltd.,Plot No.F-43,44 Others Additional Ambernath Industrial ,M.I.D.C., Ambernath - Thane-MAHARASHTRA INDIA Phone- 22-67151261,9821014902 FAX : 91-22-28571913 Pincode : 421503 Email : manikandan@chemtrols.com
145	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@iefflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA -HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@iefflowmeters.com
146	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dynafluid.com	Works-1->Mr. Yogish M. Kulkarni Dir Plot # 23, Udyambag, -Belgaum-KARNATAKA INDIA Phone- 0831-4210386 FAX : 0831-4210386 Pincode : 590008 Email : yogish@dynafluid.com
147	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com
148	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
149	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
150	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@comfit.com	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com
151	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE- MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com
152	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com	
153	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com

154	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
155	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla- MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
156	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R- 628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com
157	ELECTROMAGNETIC FLOW METER	V.A Valves	Mr.Vishal Jain, Udyog Nagar, Gadaipur, Jalandhar Phone- 9872626376 Pincode : 144004 Email : support@fedrelflowmeters.com	Works-1->Mr.Vishal Jain Dir Udyog Nagar, Gadaipur, -Jalandhar-PUNJAB INDIA Phone- 01812601741,9872626376 FAX : Pincode : 144004 Email : support@fedrelflowmeters.com
158	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com	Works-1-> Plot No 4,S.No.17/1-B Kothrud Industrial Estate -Pune-MAHARASHTRA india Phone- 020 25464551 FAX : Pincode : 411038 Email : info@adeptfluidyne.com
159	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk - Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com
160	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdhnl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdhnl@vsnl.com
161	ELECTROMAGNETIC FLOW METER	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. S L Sadani Others 104 - 115,Electronic Complex -Indore-MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols.com



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SUB-VENDOR LIST

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 1 OF 1

ANNEXURE-I

- 1. REFER ELECTRICAL AND C&I SPECIFICATION FOR APPLICABLE SUB-VENDOR LIST FOR THE RELEVANT ITEMS.**
- 2. 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 IN THE FORMAT ATTACHED IN SECTION III AS AN INFORMATION TO BHEL.**
- 3. ACCEPTANCE OF MAKES SHALL BE SUBJECT TO BHEL/ END CUSTOMER ACCEPTANCE DURING THE DETAILED ENGINEERING WITHOUT COST AND DELIVERY IMPLICATION TO BHEL.**



3x660 MW NABINAGAR STPP

GYP SUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION
MANDATORY SPARES LIST

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 1 OF 6

ANNEXURE-II

MANDATORY SPARES LIST



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION
MANDATORY SPARES LIST

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 2 OF 6

I. MECHANICAL

Sl. NO.	PARTICULARS	QUANTITY
1.	Hydro-cyclones (Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)	
a.	Hydro-cyclone Isolation Valve	10% of each type OR 1 no. whichever is higher
b.	Hydro-Cyclone	10% of each type OR 1 no. whichever is higher
c.	Hydro-Cyclone rubber lining-Feed chamber and Overflow chamber	10% of each type OR 1 no. whichever is higher
d.	Vortex finder & Apex inserts	10% of each type OR 1 no. whichever is higher
2.	Vacuum Belt Filter	
a.	Filter Cloth	6 sets
b.	Belt	2 sets
c.	Vacuum Box Seals	3 sets
d.	Drive Motor	1 no.
3.	Vacuum Pumps	
a.	Pump Impeller Assembly	1 no.
b.	Pump Bearing	1 set
c.	Seals	1 set
d.	Motor	1 no.
e.	V-belt	2 no.
3.	Vacuum Breaker Valves	
a.	Valve Assembly	1 no.
b.	Actuator	1 no.
4.	Slurry Pumps	
a.	Impeller Assembly	6 no. of each type and size
b.	Complete Casing	2 no. of each type and size
c.	Casing Liners (where replaceable liners are provided)	2 set*
d.	Seals	6 set of each type and size
e.	Bearings	4 no. of each type and size
f.	Motor	1 no. of each type and size
g.	Gear Box	1 no. of each type and size of pump
h.	Motor-Pump Coupling	1 no. of each type



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

**TECHNICAL SPECIFICATION
MANDATORY SPARES LIST**

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 3 OF 6

5.	Slurry Valves	6 nos. of each type and size
6.	Slurry Line Bends	6 nos. of each type and size
7.	Sump Pumps	
a.	Complete Impeller Assembly	1 no. of each type
b.	Casing Liners	1 set* of each type
c.	Bearing	3 set
d.	Motor	4 no. of each type
e.	Pump discharge valve assembly	1 no. of each type
e.	V-belt	2 Set
8.	Horizontal Centrifugal Pumps	
a.	Complete Impeller Assembly	2 nos. of each type
b.	Casing Liners	2 set* of each type
c.	Bearing	2 set*
d.	Motor	1 no. of each type
e.	Pump discharge valve assembly	2 nos. of each type
e.	V-belt	3 Set
Any change in size, material, design etc., which obviates one to one replacement of the part shall be considered a different type.		
*Unless otherwise stated, a set shall mean complete replacement for one equipment.		

Note(s):

- One set means 100% complete replacement of the particular component/equipment, as mentioned i.e., Set for the particular equipment, would include all components required to replace the item. For example, a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.
- Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.
- In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
- Any item which is quoted as "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there is any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.



3x660 MW NABINAGAR STPP

SPECIFICATION NO. PE-TS-457-571-A101

GYPSUM DEWATERING SYSTEM

SECTION : I

SUB-SECTION : D

**TECHNICAL SPECIFICATION
MANDATORY SPARES LIST**

REV 00

SHEET 4 OF 6

5. Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

6. All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or pre-programmed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

7. Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

II. MANDATORY SPARES - CONTROL & INSTRUMENTATION

SI. NO.	PARTICULARS	QUANTITY
1.01.00	MEASURING INSTRUMENTS	
1.01.01	(i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.	10% or 1 no. of each type and model, whichever is more.
1.01.02	Temp Elements along with thermo-well (except winding temp elements of motor)	10% or 2 no. of each type, model & length, whichever is more.
1.01.03	(i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp) (ii) Limit switches (for pneumatic and manual valves)	10% or 2 no. of each type and model, whichever is more.
1.01.04	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.
1.02.00	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS	
a.	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
b.	Filters, light source, sensor, detector, etc.	100% of each type, model and rating
c.	Complete Probe with shield assembly (Not applicable for In situ-path)	1 no. of each type and model
d.	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

**TECHNICAL SPECIFICATION
MANDATORY SPARES LIST**

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 5 OF 6

1.03.00	PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)	
a.	Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.
b.	2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.
c.	Fittings	10% or 1 packet of each type, class, size and model whichever is more.
d.	Purge meters	5% of each model or 1 no. whichever is more.
e.	Filter regulators	20% of each model or 2 nos. whichever is more.
1.04.00	CONTROL VALVES, ACTUATORS & ACCESSORIES (Following items shall be provided under this clause for all modulating control valves being supplied under this package)	
a.	Pneumatic and electro-hydraulic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
b.	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve.
c.	Diaphragms, O' rings, seals etc. of all types make etc.	1 set for each type and rating
d.	Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more
e.	Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more
f.	Positioner units (complete unit)& accessories (link assembly)	10% or 1 no. of each type whichever is more
g.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
h.	Air lock relays	10% or 2 nos. of each type whichever is more
1.05.00	PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)	
a.	Pneumatic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
b.	Diaphragms, O' rings, seals etc. of all types make etc.	1 no of each type and rating
c.	Limit switches (complete unit) & accessories (link assembly)	10% or 2 Nos., whichever is more
d.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
e.	Solenoid valves	10% or 2 nos. of each type whichever is more



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

**TECHNICAL SPECIFICATION
MANDATORY SPARES LIST**

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 6 OF 6

1.06.00	ELECTRICAL ACTUATORS	
a.	Actuators	1 no of each type and rating
b.	Electronic PCB of all types	10% of each type & model
c.	Absolute Encoder (replaceable part)	5% of each type & model
d.	Electronic Torque sensor	5% of each type & model
NOTE:		
1	Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.	
2	Any fraction of a item shall mean the next higher.	
3	Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.	
4	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.	
5	In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.	

	3x660 MW NABINAGAR STPP	SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION	SECTION : I	
		SUB-SECTION : D	
		REV 00	
	INSPECTION AND TESTING	SHEET 1 OF 7	

ANNEXURE- III

1.01.00 INSPECTION AND TESTS DURING MANUFACTURE

- 1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.
- 1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 1.01.03 Before any item of plant or equipment leaves its place of manufacture, the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.
- 1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend, the Bidder may proceed with manufacturing having forwarded to the Owner duly certified copies of his own inspection and test results.
- The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.
- The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere in the specification.
- For electrical equipment, routine tests as per relevant IS/International standard as detailed in the specification are to be carried out on all equipments. Type tests are also to be carried out on selected equipment as detailed in the specifications of the electrical equipment concerned.
- 1.01.05 Under no circumstances, any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.
- 1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced at the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.
- 1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION : I

SUB-SECTION : D

REV 00

SHEET 2 OF 7

INSPECTION AND TESTING

representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than 30 minutes. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than 30 minutes.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnaflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 PERFORMANCE TESTS AT SITE

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required.



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

INSPECTION AND TESTING

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 3 OF 7

1.03.00	SPECIFIC INSPECTION REQUIREMENT FOR COMPONENTS/EQUIPMENTS
1.	Hydro-cyclones
a.	Visual
b.	Dimensional etc.
2.	Pumps :
c.	All pressure parts shall be hydraulically tested at 150% of the shut-off head or 200% of rated head, whichever is higher for 30 minutes. No leakage is allowed.
d.	Impeller and rotor 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).
e.	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
f.	List of Non-Destructive test over and above the material test are as follows: Casing: Material test, Magnetic particle (MPI), DP and Hydro test, as applicable Impeller- DPT and MPI as applicable Shaft- Ultrasonic (UT), DPT and MPI Sleeve- DP and Hardness test/ Manufacturer's recommendation Mechanical Seal- Manufacturer's recommendation. Base Plate- Stress relieving of weld. Replaceable Rubber liner- Shore Hardness, Class and Type certificate
g.	Vibration test and Noise level test shall be witnessed at shop. (as already stated above.)
h.	Mechanical running and the performance test shall be conducted for Pump at the Bidder's works before dispatch or where the test facilities are available. All pumps to be performance tested as per Hydraulic Institute Standard/Indian Standard. Performance test to include check for noise, vibration level and temperature rise.
i.	The Bidder shall conduct performance test for the remaining pump and submit the reports.
3.	Vacuum Belt Filters:
a.	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40 mm shall be 100% Ultrasonically tested.
b.	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.
c.	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.
d.	Filter cloths and belts shall be tested for physical properties as per relevant Standard.



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

INSPECTION AND TESTING

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 4 OF 7

4.	General Inspection Requirements to be considered are as below:			
1.	Sl.No.	Item	Inspection & Test Item	Remarks
	1.	Hydro-cyclones	Material certificate check	
			Dimensional Inspection	
	2.	Pumps	Material certificate check	Shaft & impeller only
			Dimensional inspection	
			Non-destructive testing	DPT on shaft & impeller
			Hydrostatic test	
			Balancing Test	Static & dynamic
			Performance test	Incl. Noise & Vibration
	3.	Motors	Material certificate check	
			Non Destructive Testing	
			Dimensional inspection	
			Balancing Test	Static & dynamic
			Function test	
	4.	Vacuum Belt filter (with Accessories)	Material certificate check	
			Dimensional inspection	
			Function test	Short time no load test
	5.	Vacuum Receiver	Material certificate check	
			Dimensional inspection	
			Hydrostatic Test	
	6.	Belt Filter Vent Fan	Material certificate check	
			Dimensional inspection	
			Performance Test	
	7.	Conveyor & Silo Extraction Device	Material certificate check	
			Dimensional inspection	
			Function Test	Short time no load test
	8.	Rubber lining Pipe	Dimensional inspection	
			Visual Inspection	
			Spark Test	
	9.	Flow Nozzles	Material certificate check	
			Dimensional Inspection	



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION : I

SUB-SECTION : D

REV 00

SHEET 5 OF 7

INSPECTION AND TESTING

	10.	Control Panel	Insulation Resistance Test	
			Dielectric Strength Test	
			Function Test	
			Dimensional Inspection	
	11.	Control valve & valves	Material certificate check	
			Hydrostatic test	
			Seat leak test	
			Function test	
			Dimensional Inspection	
	12.	RTD	Material certificate check	
			Performance test	
			Hydrostatic test	
	13.	Shut off valve	Material certificate check	
			Hydrostatic test	
			Seat Leak test	
			Function Test	
			Dimensional Inspection	
	14.	Flow meter	Material certificate check	
			Calibration Test	
			Dimensional Inspection	
			Hydrostatic test	
	15.	Butterfly Valve	Material Certificate check	
			Non-destructive testing	
			Hydrostatic test	
			Operation test	Motorized valve only
2.	Valves and Specialties shall be tested as per relevant standards / codes. Seat Leakage and hydraulic test to be carried out as per relevant standards /codes.			
3.	Pipes and fittings shall be tested as per relevant standards/ codes			
4.	MQP (Manufacturing Quality Plan) shall be submitted by the bidder along with the technical offer. Above mentioned item-wise inspection requirement is tentative only and shall be mutually discussed and finalized during detail engineering.			



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
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INSPECTION AND TESTING

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 6 OF 7

5.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BHEL / BHEL's Customer prior to manufacture. Inspection of above mentioned tests by BHEL/ BHEL's Customer representative at bidder's works is envisaged
6.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL / BHEL's Customer.
7.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/ BHEL's Customer within one (1) week of the successful completion of balancing.
8.	Vibration levels shall be measured during shop running/performance tests.
9.	For surfaces with rubber lining, Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
10.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
11.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
12.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air pockets (or) surface without adherence.
13.	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
14.	Equipment shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
15.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment's.
16.	BHEL/BHEL's Customer of their authorized third party inspection agency representative shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
17.	Bidder to arrange all calibrated gauges, Instruments during inspection at works and also during performance test at site. All inspection, measuring and test equipment(s) used by Bidder shall be calibrated (<i>at accredited laboratory, as applicable</i>) periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
18.	Mechanical running test shall be carried out for Vacuum Belt Filter, Vacuum Pump & Belt Filter Wash Pump. Bidder to arrange Motor for the shop test and inspection.
19.	In case, order is placed on a foreign vendor (i.e. supplies from outside India), vendor will tie-up with BHEL approved inspection agency on their own cost and carry out inspection as per the Quality Plan approved by BHEL/ BHEL's Customer. Vendor shall furnish BHEL the inspection reports and other documents required as per approved Quality plan duly signed by the Inspection Agency after their witness for our review and acceptance.

SUB-SECTION-V-QM1

FLUE GAS DESULPHURISATION SYSTEM

CLAUSE NO.	QUALITY ASSURANCE	
	FLUE GAS DESULPHURISATION SYSTEM To be read along with Section I-Sub Section D - Annexure III (INSPECTION AND TESTING)	
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.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System Page 1 of 4

CLAUSE NO.	QUALITY ASSURANCE To be read along with Section I-Sub Section D - Annexure III (INSPECTION AND TESTING) 		
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.		
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. 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.		
1.06.0	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		
1.07.0	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.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System	Page 2 of 4

CLAUSE NO.	QUALITY ASSURANCE	
To be read along with Section I-Sub Section D - Annexure III (INSPECTION AND TESTING)		
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.	
1.08.0	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) 100% RT/UT on butt-welds of plate thickness$\geq 32\text{mm}$. ii) For plates of $25\text{mm}\leq\text{thickness}<32\text{mm}$-10% RT and 100% MPI. iii) For plates of thickness $<25\text{mm}$-10% MPI/LPI.	
1.08.04	Edge for shop and field weld shall be examined by MPI for plate thickness $\geq 32\text{mm}$.	
1.09.0	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.	
1.10.0	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.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System
		Page 3 of 4

CLAUSE NO.	QUALITY ASSURANCE	
1.11.0	To be read along with Section I-Sub Section D - Annexure III (INSPECTION AND TESTING)	
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	
1.12.0	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.	
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	
1.13.0	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 conforming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.	
1.14.0	OTHER CRITICAL EQUIPMENTS:	
1.14.01	Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System Page 4 of 4

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN				SPEC. NO : PE-TS-457-571-A101			DATE:		
				CUSTOMER : NPGCPL, NABINAGAR				QP NO.: PE-V0-457-571-A101			DATE:17.02.2020		
				PROJECT:3X 660MW, NABINAGAR				PO NO.:			DATE:		
				ITEM: GYPSUM DEWATERING SYSTEM		SYSTEM: FGD		SECTION:			SHEET 1 of 9		
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/ N				D	M	C	N

1.0 RAW MATERIAL (*Material shall be as per Drawing)

1.1	Vacuum pump	Physical & Chemical for impeller, casing, shaft.	MA	Physical	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	NOTE-5
		NDT of Impeller, casing, shaft, sleeve	MA	DPT	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	NOTE-5
		Balancing of Rotating Parts	MA	Static & Dynamic Balancing	100%	100%	ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	IR	√	P	V	V	NOTE-5
		NDT of Impeller & Shaft	MA	UT	100%	100%	ASTM A 388/ASME sec.V	ASTM A 388/ASME sec.V	IR	√	P	V	V	UT of shaft ≥φ 40mm NOTE-5
1.2	Speed reducer	Visual, dimensional, Run test including oil leakage, Temp.	MA	Visual	100%	100%	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	IR	√	P	V	V	

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	Sign & Date	Name		Sign & Date	Name
Prepared by:		RAJESH RANJAN	Checked by:		ASHISH PANIGRAHI
Reviewed by:		PANKAJ KR KAPSIMAY	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

		MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN					SPEC. NO : PE-TS-457-571-A101				DATE:	
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					PROJECT:3X 660MW, NABINAGAR					PO NO.:				DATE:	
					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD		SECTION:				SHEET 2 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6		7	8	9	*	**				
					M	C/ N					D	M	C		N
		rise, Noise level and vibration													
1.3	AC Drive	Type, Make, Rating, Routine test.	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	REFER ELECTRICAL QP FOR DETAILS NOTE-5	
1.4	Belt	Visual & review of test certificate (Tensile, Elongation, Thickness)	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V		
1.5	Filter Cloth	Physical Properties (Tensile, Elongation, Thickness, air permeability test, etc.)	MA	Physical	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V		
1.6	Water Pump/ Slurry Pump	Chem. & Mech. Properties of Impeller, Casting,	MA	Chemical Mechanical	100%	100%	Approved Drawing/Data sheet/Relevan	Approved Drawing/Data sheet/Relevan	TC	√	P	V	V	UT of shaft ≥ϕ 40mm *Lining if applicable	

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BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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					PROJECT:3X 660MW, NABINAGAR						PO NO.:				DATE:	
					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD			SECTION:				SHEET 3 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS		
1	2	3	4	5	6		7	8	9	*	**					
					M	C/ N				D	M	C	N			
		Shaft, Lining*					t Standard	t Standard								
		Balancing of Rotating Parts	MA	Static & Dynamic Balancing	100%	100%	ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	IR	√	P	V	V			
		Hydro test of casing	MA	Static pressure testing	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	Hydrostatic testing of casings for 30min.at 1.5 times of shut-off head or 2 times pump rated head which ever higher.		
		NDT of Impeller, casing, shaft, sleeve	MA	DPT	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V			
		NDT of Impeller & Shaft	MA	UT	100%	100%	ASTM A 388/ASME sec.V	ASTM A 388/ASME sec.V	IR	√	P	V	V	UT of shaft ≥ϕ 40mm		

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					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD		SECTION:				SHEET 4 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6		7	8	9	*	**				
					M	C/ N					D	M	C		N
1.7	Hydro cyclone	Visual & Dimension	MA	Visual & Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	NOTE-5	
1.8	Valves (Control valve & Butterfly Valve etc*)	Material certificate Hydrostatic test Seat leak test Function test DimensionS	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	*As applicable NOTE-5	
1.9(a)	Rubber Composition	Material content	MA	Chemical	1/Batc h	1/Batc h	Approved Drawing/Data sheet	Approved Drawing/Data sheet	COC	√	P	V	V		
1.9(b)	Rubber lining	Spark test at accessible area	MA	Inspection check	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	Spark test 10-12.5KV min.	
1.10	LT Motor	Make, Rating, Type, Routine Test, Paint	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	For Motor up to 30KW COC Will be submitted. NOTE-5	

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					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD			SECTION:				SHEET 5 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS		
1	2	3	4	5	6		7	8	9	*	**					
					M	C/ N					D	M	C		N	
1.11	Junction Box	Type Test- Enclosure Protection Test	MA	Visual	One of Design	One of Design	IS:60529	IS:60529	IR	√	P	V	V	NOTE-5		
1.12	Instruments (Transmitters, Switches, Gauges, RTD etc.)	COC/Functional Check	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V			
2.0	FINAL INSPECTION(Vacuum belt filter assembly)															
2.1	Vacuum belt filter assembly	Dimensional	MA	Dimensional	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	W			
		Run test(for 30 minutes)	MA	Visual, Measurement	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	W			
2.2	All components required paints.	Paint Finish, Paint Thickness, High voltage porosity test	MA	Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V			

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				PROJECT:3X 660MW, NABINAGAR						PO NO.:				DATE:	
				ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD			SECTION:				SHEET 6 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6		7	8	9	*	**				
					M	C/ N				D	M	C	N		
2.3	Vacuum pump/ Water Pump/ Slurry Pump	Capacity, power, pressure, efficiency, noise, vibration, temperature rise	MA	Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	NOTE-5	
3	VACCUM TANK (RAW MATRIAL INSPECTION)														
3.1	Plates for shell and dished ends & structural	Chemical & Physical	MA	Chemical & Physical	1 /Heat	1 /Heat	Approved Data Sheet /Drawing	Approved Data Sheet /Drawing	TC	√	P	V	V		
4.0	IN PROCESS CONTROLS														
4.1	Welding (As applicable)	WPS,PQR,WPQ	CR	Visual	100%	100%	ASME Sec, IX/Relevant Standard	ASME Sec, IX/Relevant Standard	Report	√	P	V	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		RAJESH RANJAN	Checked by:		ASHISH PANIGRAHI
Reviewed by:		PANKAJ KR KAPSIMAY	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

		MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN					SPEC. NO : PE-TS-457-571-A101				DATE:	
					CUSTOMER : NPGCPL, NABINAGAR					QP NO.: PE-V0-457-571-A101				DATE:17.02.2020	
					PROJECT:3X 660MW, NABINAGAR					PO NO.:				DATE:	
					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD		SECTION:				SHEET 7 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6		7	8	9	*	**				
					M	C/ N					D	M	C		N
4.2	Stress Relieving	Physical	MA	Physical	100%	100%	Relevant Standard/Ma nufacturer standard	Relevant Standard/Ma nufacturer standard	HT chart	√	P	V	V	As applicable	
4.3	All Weld	Weld Quality	MA	DPT	10%	10%	Relevant Standard /ASME Sec – VIII Div.1	Relevant Standard /ASME Sec – VIII Div.1	IR	√	P	W	V		
4.4	Weld quality of circumferential & longitudinal seams	Weld Defect	CR	RT- Review of documents	10%	10%	Relevant Standard /ASME Sec – VIII Div.1	Relevant Standard /ASME Sec – VIII Div.1	IR	√	P	V	V		
5.0	FINAL INSPECTION(Complete System)														
5.1	Complete System	Dimensional	MA	Dimension	100%	100%			Approved Drawing	√	P	W	V	NOTE-5	
		Nozzle Orientation	CR	Dimension	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	V	NOTE-5	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		RAJESH RANJAN	Checked by:		ASHISH PANIGRAHI			Reviewed by:			
Reviewed by:		PANKAJ KR KAPSIMAY	Reviewed by:		RK JAISWAL			Approved by:			

		MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN					SPEC. NO : PE-TS-457-571-A101				DATE:	
					CUSTOMER : NPGCPL, NABINAGAR					QP NO.: PE-V0-457-571-A101				DATE:17.02.2020	
					PROJECT:3X 660MW, NABINAGAR					PO NO.:				DATE:	
					ITEM: GYPSUM DEWATERING SYSTEM			SYSTEM: FGD		SECTION:				SHEET 8 of 9	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
1	2	3	4	5	6		7	8	9	*	**				
					M	C/ N					D	M	C		N
		Hydro Test	CR	Hydro Test	100%	100%	2X working PR or 1.5x design PR Whichever is higher for 30 minutes	2X working PR or 1.5x design PR Whichever is higher for 30 minutes	IR	√	P	W	V	NOTE-5	
		Pneumatic Test of RF pads for soundness /leakages	CR	Pneumatic Test	100%	100%	ASME SEC – VIII /appd. Drg/appd. Datasheet	ASME SEC – VIII /appd. Drg/appd. Datasheet	IR	√	P	W	V	*as applicable NOTE-5	
5.2(a)	Rubber Lining of tank	Spark test	MA	Electrical	100%	100%	Technical Spec/ Relevant standard	Technical Spec/ Relevant standard	IR	√	P	V	V	Spark test 10-12.5KV min.	
5.2(b)	Rubber Lining of tank	Hardness testing	MA	Physical	100%	100%	Technical Spec/ Relevant standard	Technical Spec/ Relevant standard	IR	√	P	W	V	Shore hardness value shall be within 60. NOTE-5	
5.3	Junction Box	Insulation Resistance Test High Voltage Test	MA	Electrical	100 %	10%	Approved Drawing	Approved Drawing	IR	√	P	W	V	NOTE-5	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		RAJESH RANJAN	Checked by:		ASHISH PANIGRAHI			Reviewed by:			
Reviewed by:		PANKAJ KR KAPSIMAY	Reviewed by:		RK JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN				SPEC. NO : PE-TS-457-571-A101		DATE:				
				CUSTOMER : NPGCPL, NABINAGAR				QP NO.: PE-V0-457-571-A101		DATE:17.02.2020				
				PROJECT:3X 660MW, NABINAGAR				PO NO.:		DATE:				
				ITEM: GYPSUM DEWATERING SYSTEM		SYSTEM: FGD		SECTION:		SHEET 9 of 9				
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS		
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
5.4	Painting & Marking	Paint Finish, Thickness, HV porosity test	MA	Visual	100%	100%	Appd. Drg /Data Sheet	Appd. Drg /Data Sheet	IR	√	P	V	V	NOTE-5
5.5	Packing	Proper Packing	MA	Visual	100%	100%	Technical Spec	Technical Spec	Packing List	√	P	V	V	NOTE-2,5
5.6	Quality Dossier	Document	MA	Visual	100%	100%	Compilation of documents	Compilation of documents	Quality Dossier	√	P	V	V	

LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
 ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,
 P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
 MA: MAJOR, MI: MINOR, CR: CRITICAL
 IR: INTERNAL REPORT D: DOCUMENTATION
 RT: RADIOGRAPHY TEST UT: ULTRASONIC TEST DPT: DIE PENETRANT TEST

NOTE:

1. ORIGINAL TCS/ PHOTOCOPIES CERTIFIED IN ORIGINAL BY MILL SHALL BE FURNISHED FOR REVIEW.
2. PACKING PHOTO GRAPH IS TO BE SUBMITTED TO BHEL BEFORE DISPATCH.
3. BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.
4. DURING TESTING ONLY CALIBRATED MEASURING AND TESTING INSTRUMENT IS TO BE USED AND. CALIBRATION CERTIFICATES ARE NEEDED TO BE FURNISHED DURING INSPECTION.
5. THESE TESTS/CHECKS ARE INDICATIVE ONLY. FURTHER TESTS MAY BE ADDED BASED ON END CUSTOMER REQUIREMENT AND WILL BE FINALISED DURING DETAILED ENGINEERING

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		RAJESH RANJAN	Checked by:		ASHISH PANIGRAHI			Reviewed by:			
Reviewed by:		PANKAJ KR KAPSIMAY	Reviewed by:		RK JAISWAL			Approved by:			



**3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

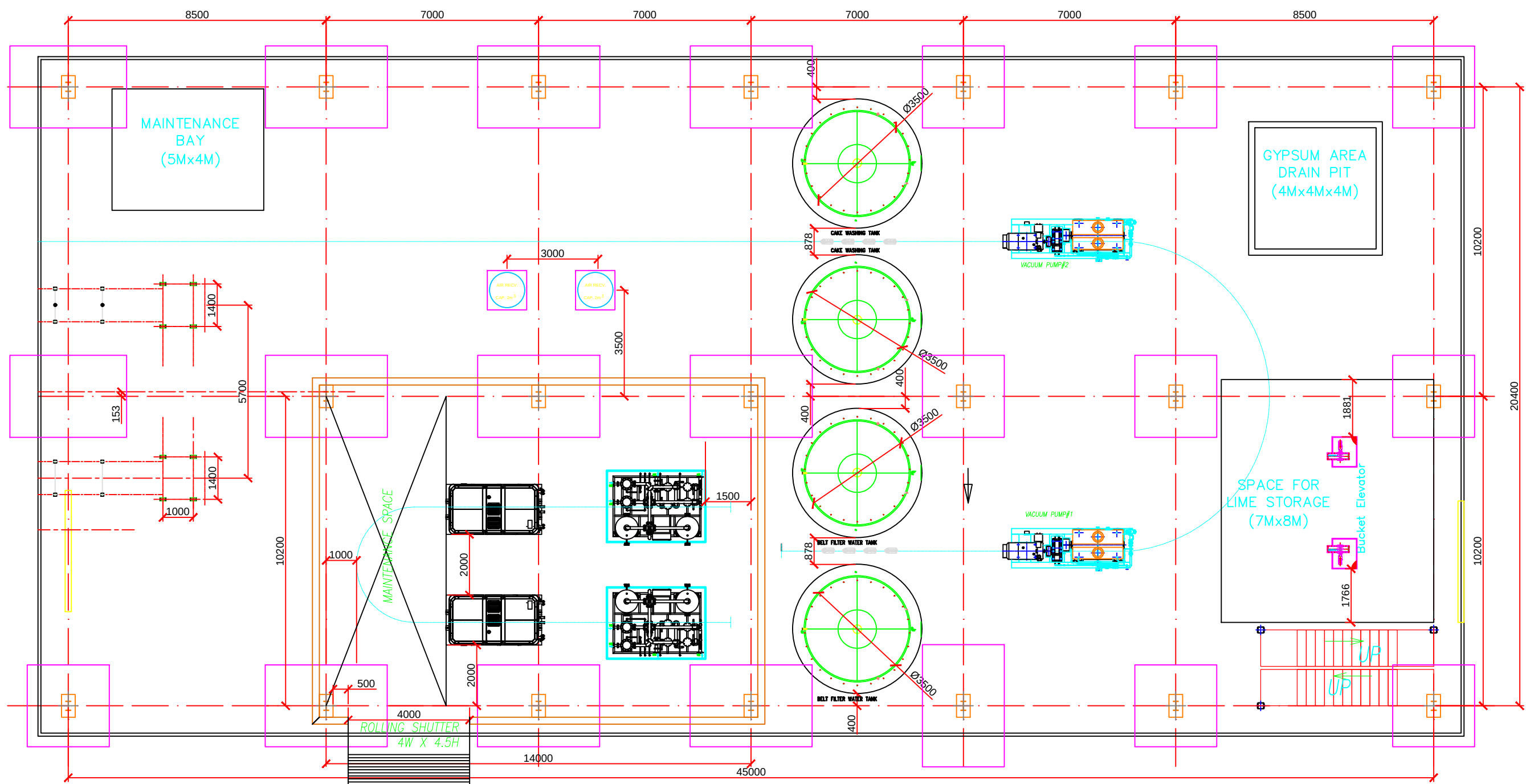
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SPECIFICATION No: PE-TS-457-571-A101
SECTION : I
SUB-SECTION : D
REV 00
SHEET 1 OF 1

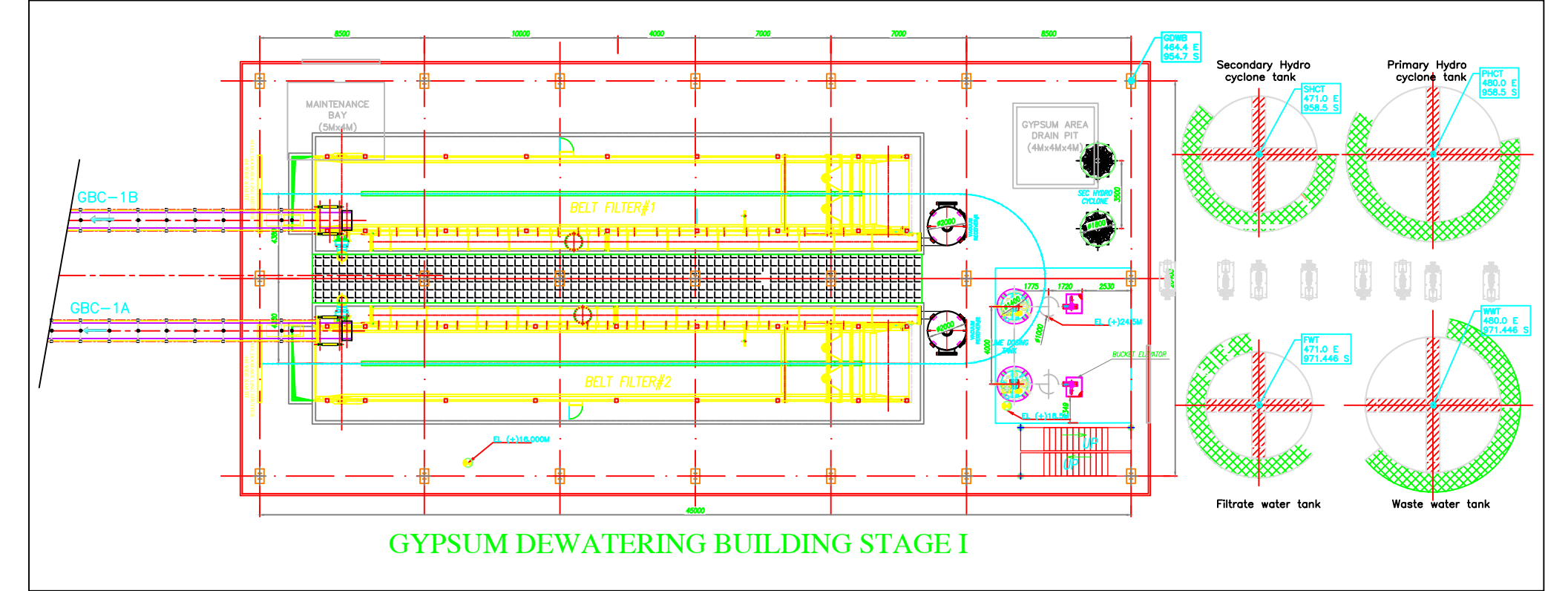
ANNEXURE-IV

INPUT DRAWINGS/DOCUMENTS BY BHEL

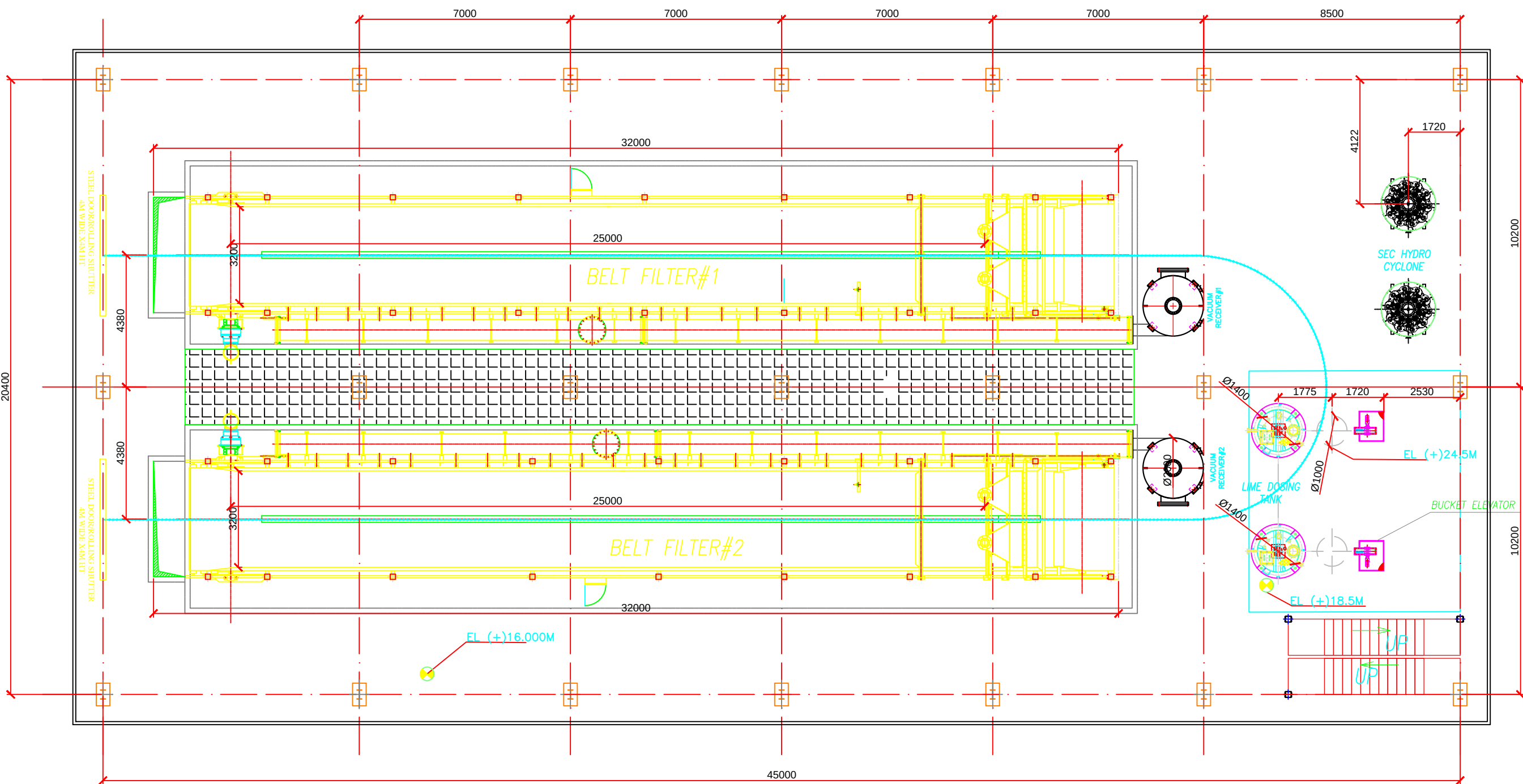
Sl.No.	Drawing/Document Title	NPGCPL/BHEL Drawing No.
1.	General Arrangement of Dewatering building	0370-109-PVM-B-047
2.	P&ID - Legends & Notes	0370-109-PVM-F-020 (Sheet 1 & 2 of 15)
3.	P&ID - Primary Hydrocyclone	0370-109-PVM-F-020 (Sheet 3 & 4 of 15)
4.	P&ID of Vacuum Belt filter	0370-109-PVM-F-020 (Sheet 5 to 10 of 15)
5.	Filtrate Extraction Pump Scheme	PE-FEP-00
6.	P&ID of Secondary Hydrocyclone	0370-109-PVM-F-020 (Sheet 11 & 12 of 15)
7.	Plant Layout of FGD System	0370-109-PVM-F-044
8.	Painting Scheme for FGD System, Booster Fan and Gates & Dampers	0370-109-PVM-H-001



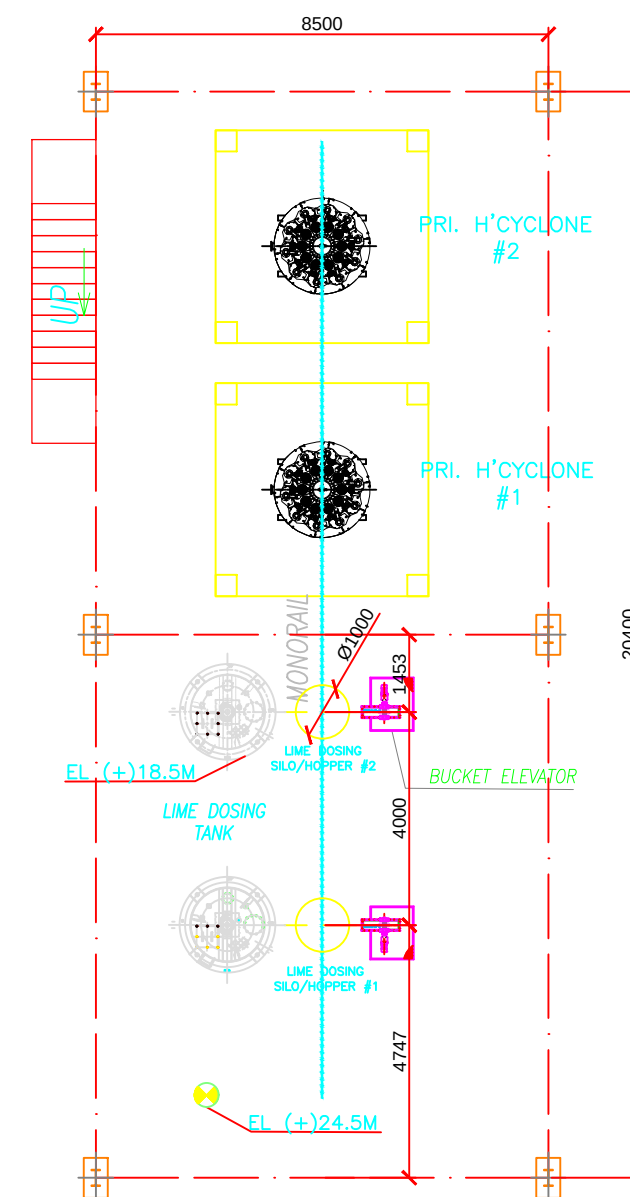
PLAN @ EL(+).0.0m



KEY PLAN



PLAN @ EL(+).15.5 m

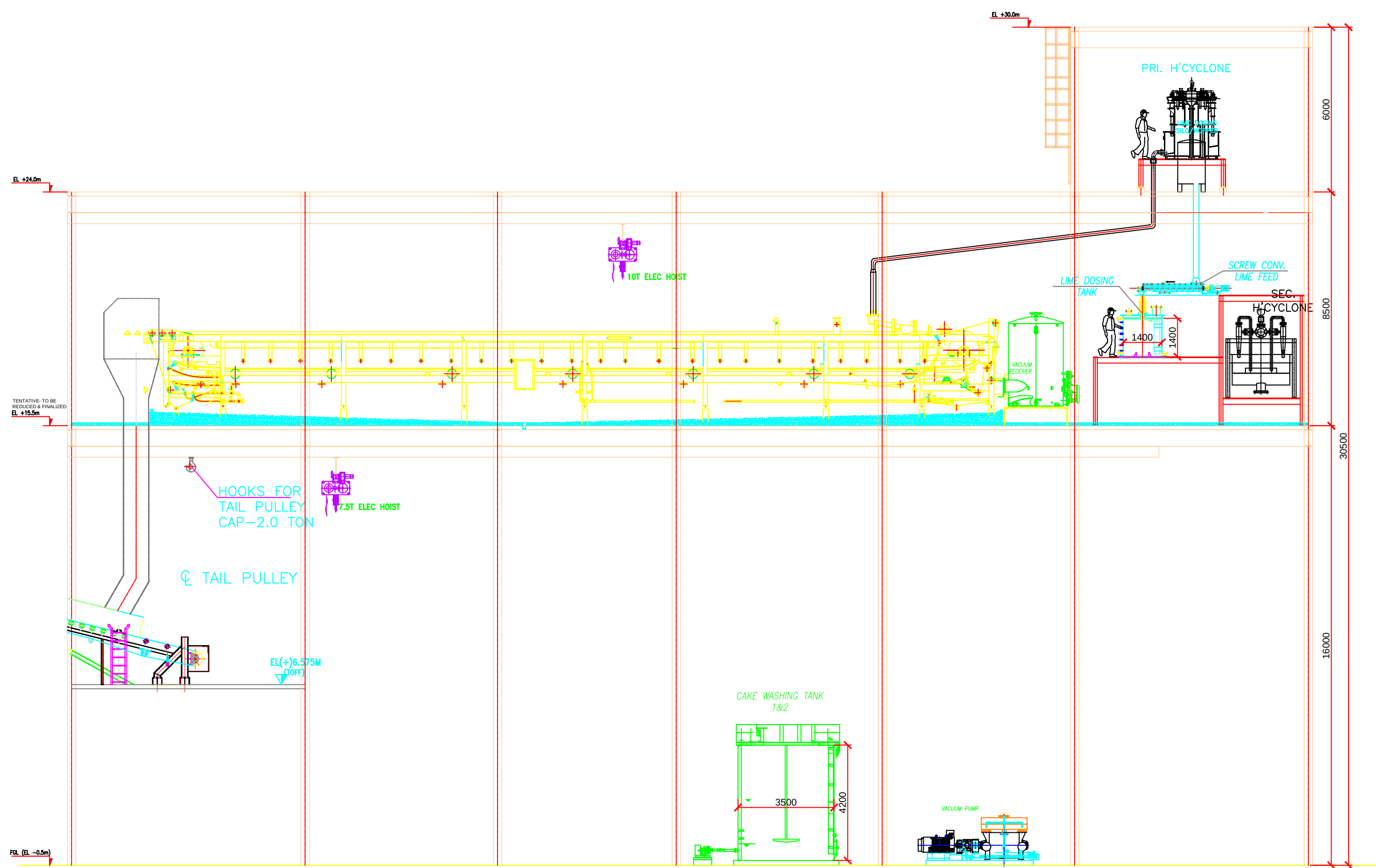


PLAN@ EL 24.0m

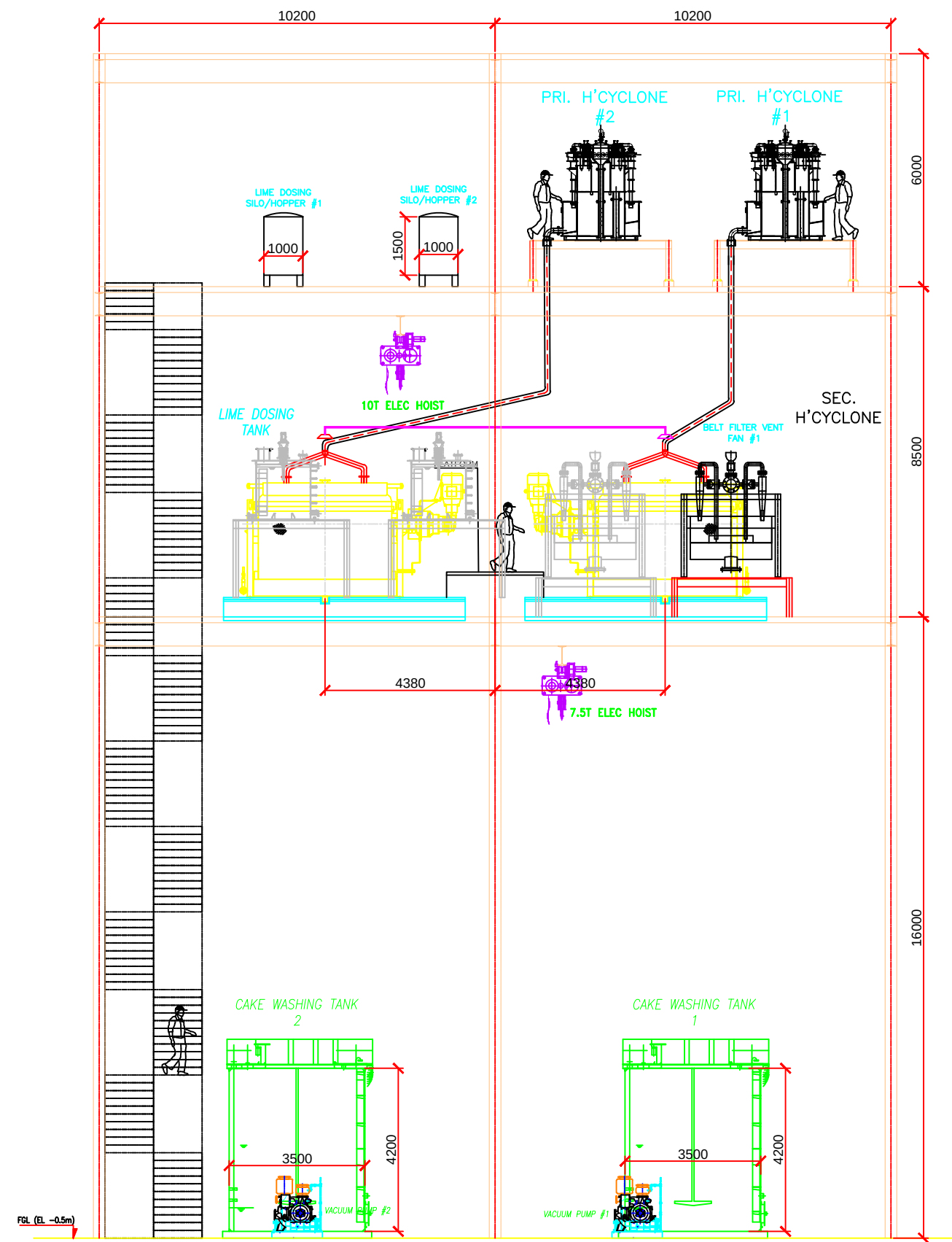
Please refer this drawing along with GA of GDWS (Sheet 2 of 2) 0-FW-000-01414

Rev	Date	Drawn	Checked	Approved	Remarks

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		NABINAGAR STPP, STAGE-1 3x660MW	
Bharat Heavy Electricals Ltd		BOILER AUXILIARIES PLANT	
RANIPET-632 406		GA of GDWS	
Sh 01 of 02		0-FW-000-01413	
DEPT		SCALE	
GRADE OF UNITS		1:100	
CODE		WEIGHT (Kg)	
U 01		*****	
TITLE		REF TO ASBY / OLD DWS	
GA of GDWS		ITEM NO	
Sh 01 of 02		REV	
U 01		00	



SECTION - BB

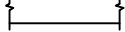


SECTION - AA

Rev	Date	Drawn	Checked	Approved	Remarks

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		NABINAGAR STPP, STAGE-1 3x660MW	
05-227/D		Bharat Heavy Electricals Ltd	
PR/GAS500		BOILER AUXILIARIES PLANT	
RANIPET-632 406		RANIPET-632 406	
DEPT	GRADE OF UNITS, DM	SCALE	WEIGHT (kg)
CODE	PR/GAS500	1:100	*****
TITLE		GA of GDWS	REV
Sh 02 of 02		U 01	00
DRAWING NO :		0-FW-000-01414	

LINE SYMBOLS

SYMBOLS	NAME
	PIPE LINE
	CAPILLARY TUBING
	ELECTRIC SIGNAL
	SOFTWARE LINK
	PRESSURE LEAD
	DUCT

PIPING VALVE SYMBOLS

SYMBOLS		NAME
	NC	GATE VALVE (NOR.CLOSED)
	NC	GLOBE VALVE (NOR.CLOSED)
	NC	BALL VALVE (NOR.CLOSED)
	NC	BUTTERFLY VALVE (NOR.CLOSED)
	NC	DIAPHRAGM VALVE (NOR.CLOSED)
	NC	PINCH VALVE (NOR.CLOSED)
	NC	NEEDLE VALVE (NOR.CLOSED)
		CHECK VALVE
		CHECK VALVE (WAFER)
		PRESSURE RELIEF VALVE

INSTRUMENT VALVE SYMBOLS

SYMBOLS	NAME
	ACTUATED BY AIR
	ACTUATED BY MOTOR
	AIR CONTROL VALVE
	SOLENOID ACTUATOR
	SELF REGULATING VALVE
	SELF REGULATING VALVE

TRENCH SYMBOLS

SYMBOLS	NAME
 A	TO ABSORBER AREA DRAIN SUMP
 b	TO GYPSUM AREA DRAIN SUMP
 L	TO LIMESTONE AREA DRAIN SUMP

SYMBOLS FOR PIPING PARTS & INSTRUMENT PARTS

SYMBOLS	NAME
	STEAM TRAP
	AIR TRAP
	Y-STRAINER
	T-STRAINER
	TEMPORARY STRAINER
	REDUCER
	EXPANSION JOINT
	DUCT EXPANSION JOINT
	FLEXIBLE HOSE
	SPOOL PIECE
	VENT
	HOSE CONNECTION
	BLIND FLANGE
	REDUCING FLANGE
	CAP (BW)
	CAP (SCR)
	TRENCH
	SIGHT GLASS
	SILENCER
	ORIFICE
	DIAPHRAGM
	MAGNETIC FLOW METER
	VORTEX FLOW METER
	PH METER
	FILTER
	MANHOLE
	INSPECTION HOLE
	PITOT TUBE
	SAMPLING POT
	SAMPLING NOZZLE
	RESTRICTION ORIFICE

SYMBOLS FOR VALVE OPERATION

SYMBOLS	NAME
	FAILURE OPEN (THE VALVE OPENS WHEN AIR OR ELECTRICITY FOR ACTUATOR FAILS.)
	FAILURE CLOSE (THE VALVE CLOSSES WHEN AIR OR ELECTRICITY FOR ACTUATOR FAILS.)

INSULATION SYMBOLS

SYMBOLS	DESCRIPTION
H10	THERMAL INSULATION (100°C & LOWER)
H15	THERMAL INSULATION (101°C ~ 150°C)
H20	THERMAL INSULATION (151°C ~ 200°C)
H25	THERMAL INSULATION (201°C ~ 250°C)
H30	THERMAL INSULATION (251°C ~ 300°C)
H35	THERMAL INSULATION (301°C ~ 350°C)
HF	INSULATION FOR ANTI FREEZING
ET	ELECTRIC TRACE
ST	STEAM TRACE (LOW PRESSURE STEAM)
P10	PERSONAL PROTECTION (100°C & LOWER)
P15	PERSONAL PROTECTION (101°C ~ 150°C)
P20	PERSONAL PROTECTION (151°C ~ 200°C)
P25	PERSONAL PROTECTION (201°C ~ 250°C)
P30	PERSONAL PROTECTION (251°C ~ 300°C)
P35	PERSONAL PROTECTION (350°C ~ 400°C)

DELIVERY LIMITS

SYMBOLS	NAME
	BETWEEN CLIENT AND CONTRACTOR
	BETWEEN SUB CONTRACTOR AND VENDOR

SYSTEM

NUMBER	NAME
1	FLUE GAS SYSTEM
2	SO ₂ ABSORPTION OXIDATION SYSTEM
3	REHEATING SYSTEM
4	GYPSUM DEWATERING HANDLING SYSTEM
5	LIMESTONE PREPARATION SYSTEM
6	BLANK
7	SUMP SYSTEM
8	UTILITY SYSTEM

FLUID NAME

FLUID SYMBOL	FLUID NAME	FLUID SYMBOL	FLUID NAME
AA	ANTIFOAM AGENT	WCS	COOLING WATER SUPPLY
AC	COMPRESSED AIR	WCR	COOLING WATER RETURN
AF	FLUIDIZER AIR		
AI	INSTRUMENT AIR	WP	PROCESS WATER
AO	OXIDATION AIR	WR	RAW WATER
AS	SEAL AIR	WW	WASTE WATER
DD	DUCT DRAIN	VG	VACUUM PUMP VENT
FS	FILTRATE SLURRY	VBG	BELT FILTER VENT GAS
GS	GYPSPUM SLURRY	LD	LIMESTONE DEDUSTING
LS	LIMESTONE SLURRY	LOL	LUBE OIL (LOW PRESSURE)
		LOH	LUBE OIL (HIGH PRESSURE)

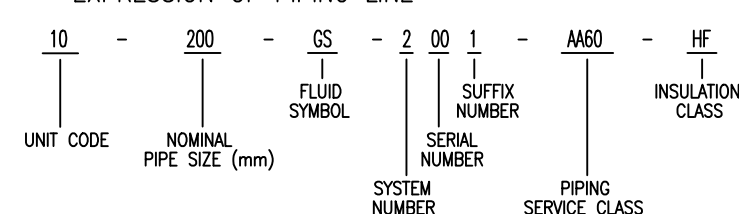
	SERVICE CLASS
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SERVICE CLASS	MATERIAL	FLUID SYMBOL
AA40	IIR RUBBER LINED PIPING	LS, WP, WC
AA60	IIR RUBBER LINED PIPING	GS,FS,WW,DD
BA01	Gr.304 STAINLESS STEEL / GI PIPING	AI, LOL
BA02	Gr.304 STAINLESS STEEL / GI PIPING	LOH
BA03	Gr.316L STAINLESS STEEL PIPING	WP, AO
CA01	CARBON STEEL GENERAL PIPING	AS,AO,AC,AF,LI
CC01	CARBON STEEL PRESSURE PIPING	WP,WR,WCS,WCS VG, AA

UNIT CODE

UNIT CODE	
SYMBOLS	UNIT IDENTIFICATION
00	COMMON
10	UNIT-1 FGD SYSTEM AND AUXILIARIES

EXPRESSION OF PIPING LINE



CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.

PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

 BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.	DEPT	NAME (BHEL)		DATE
	CODE	DRN	KABILASH	21.12.19
	M	CHD	MANOJ KT	21.12.19
	APPD	PN REDDY	21.12.19	

 MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE:	
P	& ID - LEGENDS AND NOTES

SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

SH 01 of 15

BHEL DRG NO	3-FW-000-00978
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FILE NO	B240-00601
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REV NO	01
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INSTRUMENT ABBREVIATION

	FIRST-LETTER		SUCCEEDING--LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		BLANK	BLANK	BLANK
C	BLANK			CONTROL	
D	BLANK	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	BLANK		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	BLANK	MOMENTARY			MIDDLE, INTERMEDIATE
N	BLANK		BLANK	BLANK	BLANK
O	BLANK		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT(TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

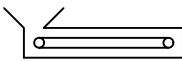
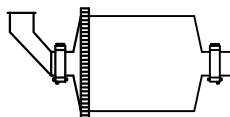
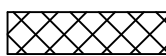
INSTRUMENT SYMBOLS

INSTRUMENT SYMBOLS	
SYMBOLS	NAME
	FIELD MOUNTED
	FOR CONTROL ROOM
	FOR LOCAL CONTROL PANEL
	FOR DCS
	INTERLOCK LOGIC

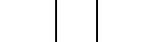
PNEUMATIC VALVE ACTUATOR

CODE NO.	ACTUATION
FLXXWA-D	DOUBLE SOLENOID NO LIMIT SWITCH
FLXXWA-DL	DOUBLE SOLENOID WITH LIMIT SWITCH
FLXXWA-S	SINGLE SOLENOID NO LIMIT SWITCH
FLXXWA-SL	SINGLE SOLENOID WITH LIMIT SWITCH

MACHINERY SYMBOLS

SYMBOLS	NAME
	PUMP
	FAN / BLOWER
	AGITATOR (FLAT BLADE)
	AGITATOR (PROPELLOR)
	ROTARY VALVE
	CRUSHER
	BELT FEEDER
	BELT FILTER
	BALL MILL
	CYCLONE
	MIST ELIMINATOR

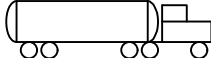
EQUIPMENT SYMBOLS

SYMBOLS	NAME
	BAG FILTER
	SILO
	SLIDE GATE
	TANDEM LOUVER DAMPER (MULTIVANE)
	SINGLE STAGE LOUVER DAMPER (MULTIVANE)
	LOUVER DAMPER (SINGLE VANE)
	DISTRIBUTION BOX (3WAY)
	DISTRIBUTION BOX (2WAY)
	SUMP
	HEAT EXCHANGER
	SHELL AND TUBE HEAT EXCHANGER
	AIR DRYER
	FILTER
	SPRAY NOZZLE

DRIVER SYMBOLS

SYMBOLS	NAME
	AIR MOTOR
	ELECTRIC MOTOR

OTHER SYMBOLS

SYMBOLS	NAME
	INSERT PIPE / LANCE
	CHUTE
	TRUCK

CUSTOMER NOS: G609, G610 & G611

CUSTOMER:	NTPC LIMITED.
PROJECT:	NABINAGAR (3X660MW) FGD SYSTEM PACKAGE

 BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RAMPET:632 406.	DEPT		NAME (BHEL)	DATE
	CODE	DRN	KABILASH	21.12.19
	M	CHD	MANOJ KT	21.12.19
		APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE:	P & ID - LEGENDS AND NOTES

SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

SH 02 of 15

FOI	BHEL DRG NO
	3-FW-000-00976

FILE NO	B240-00602
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REV NO	01
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A B C D E F G H

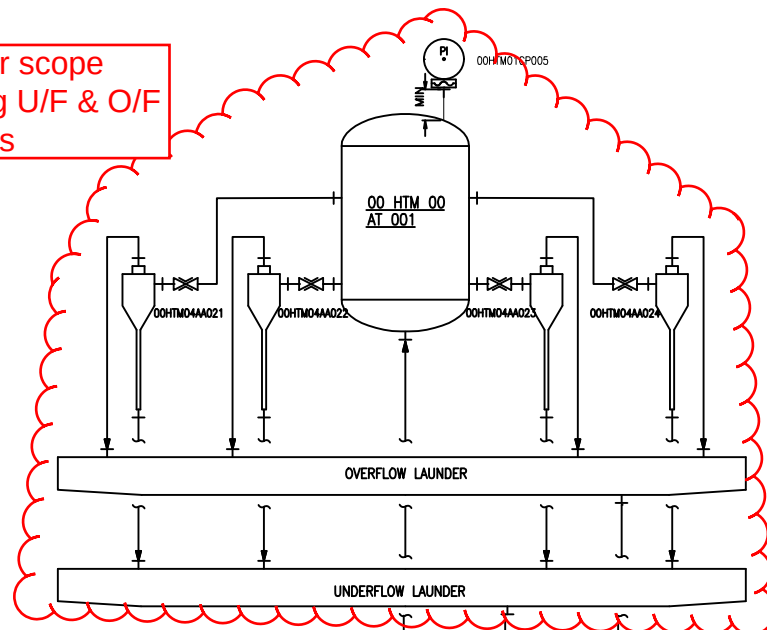
THIRD ANGLE
PROJECTION

No. REQ'D

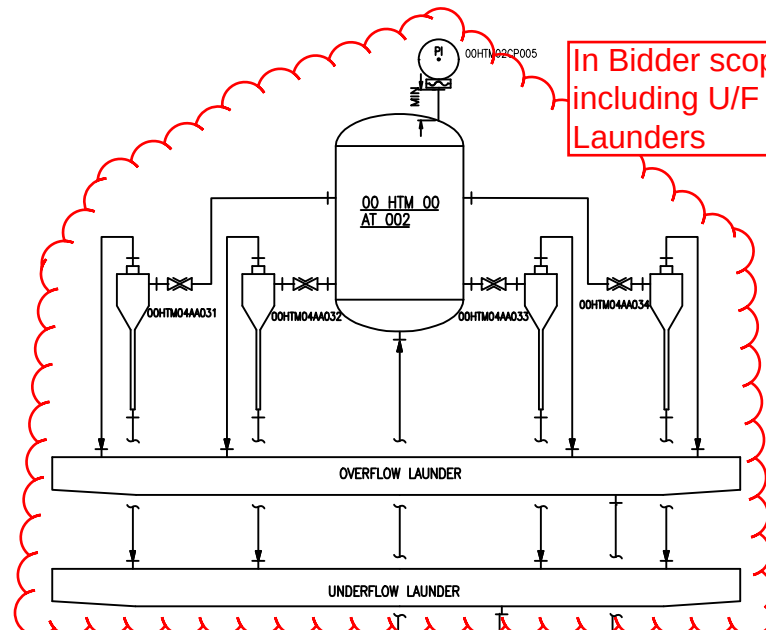
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DRAWING No.

In Bidder scope
including U/F & O/F
Launders



In Bidder scope
including U/F & O/F
Launders



Engg & supply by Bidder

Engg & supply by Bidder

Engg & supply by Bidder

Engg & supply by Bidder

Engineering by Bidder
as per sub section C1,
clause 2.1.1.9 (ii) a

Engineering by Bidder
as per sub section C1,
clause 2.1.1.9 (ii) b

Engineering by Bidder
as per sub section C1,
clause 2.1.1.9 (ii) a

Engineering by Bidder
as per sub section C1,
clause 2.1.1.9 (ii) b

Engineering & supply by
Bidder as per sub section
C1, clause 2.1.1.9 (i) a

Engineering &
supply by Bidder as
per sub section C1,
clause 2.1.1.9 (i) a

B240-00401
FROM PRIMARY HYDROCYCLONE FEED TANK PUMP A/B
00 HTM 00 AP 001/002

00-200-GS-4021-AA60

00-350-GS-4051-AA60
B240-00442
TO SECONDARY HYDROCYCLONE FEED TANK
00 HTM 04 BB 001

00-300-GS-4052-AA60
B240-00412
TO GYPSUM BELT FILTER B
00 HTM 01 AT 002

B240-00442
TO SECONDARY HYDROCYCLONE FEED TANK
00 HTM 04 BB 001

B240-00411
TO VACUUM BELT FILTER A
00 HTM 01 AT 001

B240-00401
FROM PRIMARY HYDROCYCLONE FEED TANK PUMP A/B
00 HTM 00 AP 001/002

00-200-GS-4022-AA60

00-350-GS-4041-AA60

00-300-GS-4042-AA60

00 HTM 00 AT 001/002
PRIMARY HYDROCYCLONE A/B

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.
PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

DEPT CODE	NAME (BHEL)	DATE
DRN	KABILASH	21.12.19
CHD	MANOJ KT	21.12.19
APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE:
P & ID -PRIMARY HYDROCYCLONE TANK

SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

SH 04 of 15

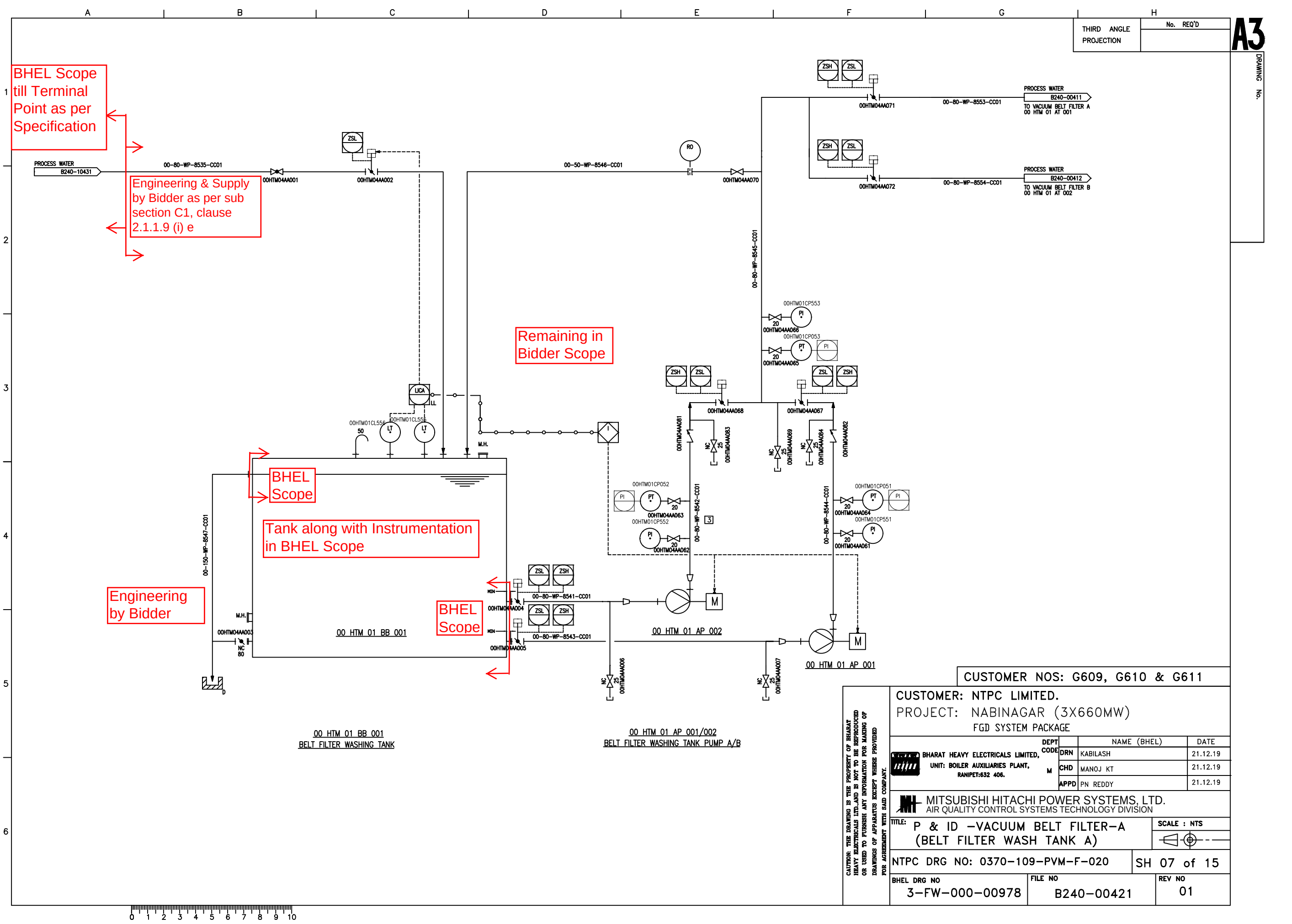
BHEL DRG NO
3-FW-000-00978

FILE NO
B240-00402

REV NO
01

CAUTION: THE DRAWING IS THE PROPERTY OF BHARAT
HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED
OR USED TO FURNISH ANY INFORMATION FOR MAKING OF
DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED
FOR AGREEMENT WITH SAID COMPANY.

0 1 2 3 4 5 6 7 8 9 10



THIRD ANGLE PROJECTION

No.	REQ'D

A3

DRAWING No.

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.
PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

DEPT CODE	NAME (BHEL)	DATE
DRN	KABILASH	21.12.19
CHD	MANOJ KT	21.12.19
APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: **P & ID -VACUUM BELT FILTER-A**
(BELT FILTER WASH TANK A)

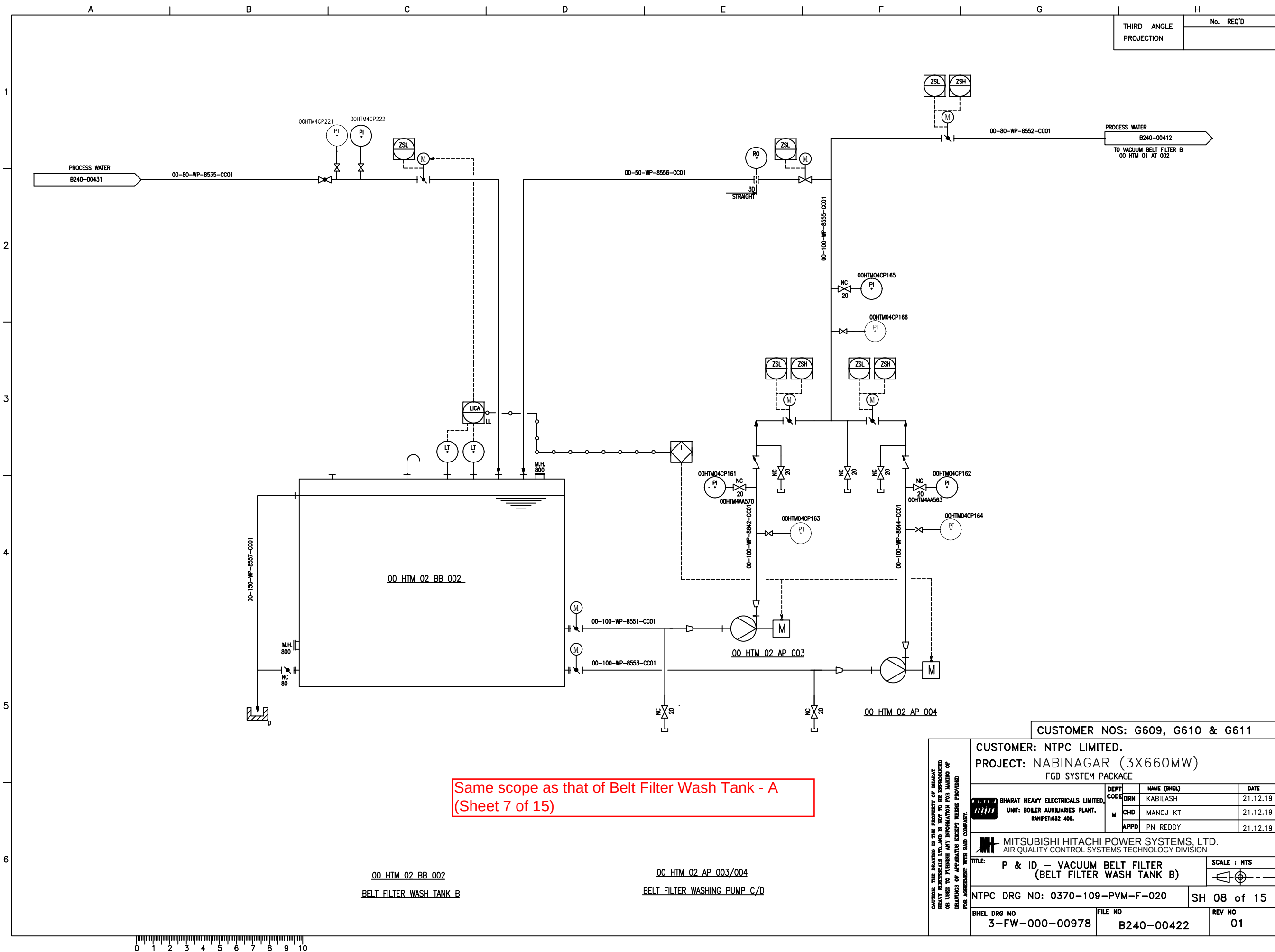
SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

SH 07 of 15

BHEL DRG NO	FILE NO	REV NO
3-FW-000-00978	B240-00421	01

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THIRD ANGLE
PROJECTION

No. REQ'D

A3

DRAWING No.

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.
PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

DEPT	NAME (BHEL)	DATE
DRN	KABILASH	21.12.19
CHD	MANOJ KT	21.12.19
APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - VACUUM BELT FILTER
(BELT FILTER WASH TANK B)

SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

SH 08 of 15

BHEL DRG NO
3-FW-000-00978

FILE NO
B240-00422

REV NO
01

BHEL Scope
till Terminal
Point as per
Specification

Engineering & Supply
by Bidder as per sub
section C1, clause
2.1.1.9 (i) e

Remaining in
Bidder Scope

BHEL
Scope

Tank along with Instrumentation
in BHEL Scope

Engineering
by Bidder

BHEL
Scope

CLARIFIED WATER TANK A
00 HTQ 01 BB 001

CLARIFIED WATER PUMP A/B
00 HTQ 03 AP 001/002

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.
PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

DEPT CODE	NAME (BHEL)	DATE
DRN	KABILASH	21.12.19
CHD	MANOJ KT	21.12.19
APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID -VACUUM BELT FILTER
CAKE WASH (CLARIFIED WATER) TANK A

SCALE : NTS

NTPC DRG NO: 0370-109-PVM-F-020

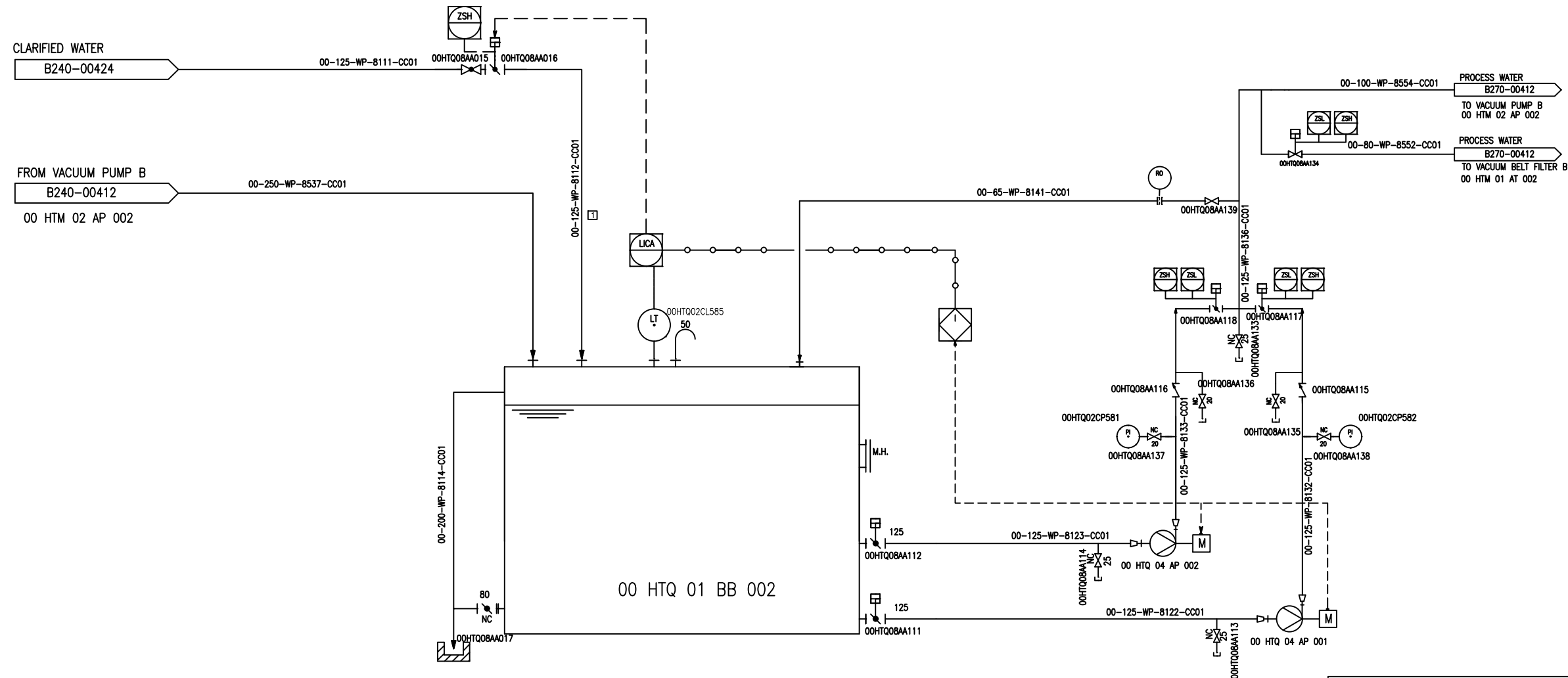
SH 09 of 15

BHEL DRG NO
3-FW-000-00978

FILE NO
B240-00423

REV NO
01

CAUTION: THE DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED FOR AGREEMENT WITH SAID COMPANY.



CLARIFIED WATER TANK B
00 HTQ 01 BB 002

CLARIFIED WATER PUMP C/D
00 HTQ 04 AP 001/002

Same scope as that of Cake Wash Tank - A (Sheet 9 of 15)

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.
PROJECT: NABINAGAR (3X660MW)
FGD SYSTEM PACKAGE

DEPT CODE	NAME (BHEL)	DATE
DRN	KABILASH	21.12.19
CHD	MANOJ KT	21.12.19
APPD	PN REDDY	21.12.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID -VACUUM BELT FILTER
CAKE WASH (CLARIFIED WATER) TANK A

SCALE : NTS

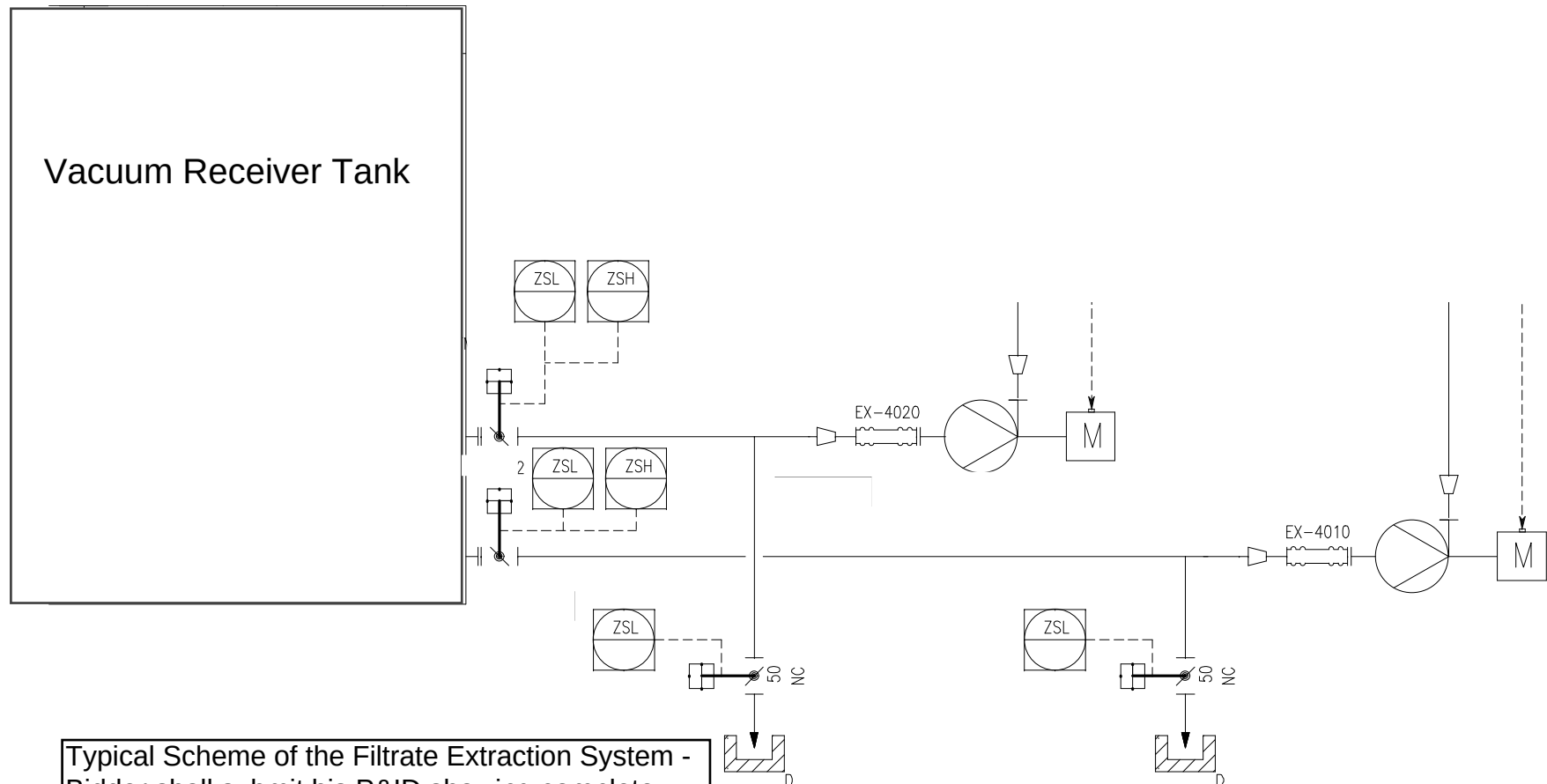
NTPC DRG NO: 0370-109-PVM-F-020

SH 10 of 15

BHEL DRG NO 3-FW-000-00978	FILE NO B240-00424	REV NO 01
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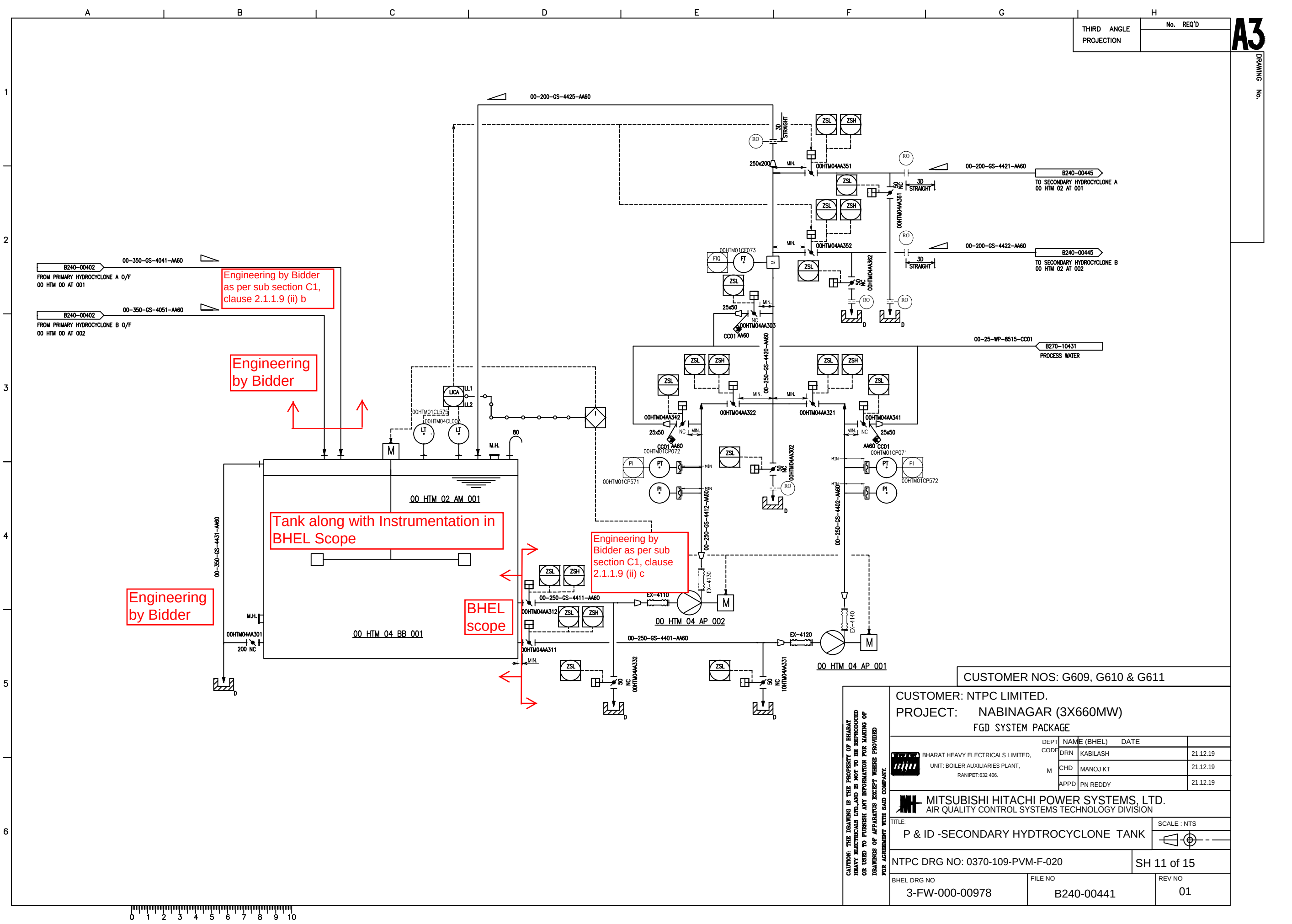
CAUTION- THE DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED FOR AGREEMENT WITH SAID COMPANY.

Bidder scope after the Pump Discharge is limited to the Engineering of the Piping up to the Filtrate Water Tank as per Clause 2.1.1.9 (ii) f of Sub-section C1, Section-I of this specification.



Typical Scheme of the Filtrate Extraction System - Bidder shall submit his P&ID showing complete arrangement for BHEL/Customer approval. Piping and Valves shall be rubber lined as per the details provided elsewhere in the specification.

Scheme No.: PE-FEP-00



THIRD ANGLE
PROJECTION

No. REQ'D

A3

DRAWING No.

Engineering by Bidder
as per sub section C1,
clause 2.1.1.9 (ii) b

Engineering
by Bidder

Tank along with Instrumentation in
BHEL Scope

Engineering
by Bidder

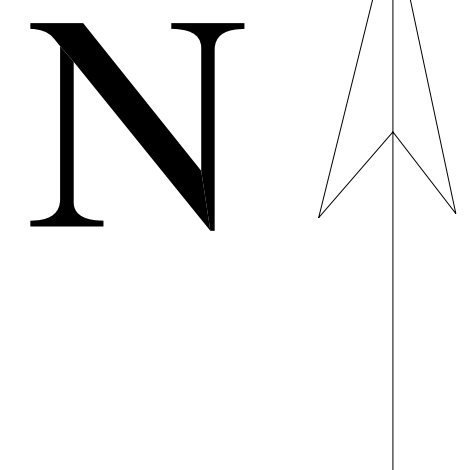
BHEL scope

Engineering by
Bidder as per sub
section C1, clause
2.1.1.9 (ii) c

CUSTOMER NOS: G609, G610 & G611

CUSTOMER: NTPC LIMITED.			
PROJECT: NABINAGAR (3X660MW)			
FGD SYSTEM PACKAGE			
 BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.	DEPT	NAME (BHEL)	DATE
	DRN	KABILASH	21.12.19
	M	CHD	MANOJ KT
	APPD	PN REDDY	21.12.19
 MITSUBISHI HITACHI POWER SYSTEMS, LTD. AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION			
TITLE: P & ID -SECONDARY HYDROCYCLONE TANK			SCALE : NTS
NTPC DRG NO: 0370-109-PVM-F-020			SH 11 of 15
BHEL DRG NO 3-FW-000-00978	FILE NO B240-00441	REV NO 01	

CAUTION: THE DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED FOR AGREEMENT WITH SAID COMPANY.



EQUIPMENT/ STRUCTURE NO	DESCRIPTION
01	NEW WET STACK
02	WET LIMESTONE BASED ABSORBER
03	RC PUMPS AND OXIDATION BLOWER HOUSE
04	BOOST UP FANS
05	AUXILIARY ABSORBENT TANK
06	AUXILIARY ABSORBENT TANK PUMP
07	COMPRESSOR HOUSE
08	ACW PUMP HOUSE
09	FGD CONTROL ROOM
10	ELEVATOR FOR ABSORBER
11	PIPE AND CABLE RACK
12	LIMESTONE STORAGE SILOS
12A	ELEVATOR FOR LIMESTONE GRINDING SYSTEM
13	BALL MILL BUILDING
14	WET LIMESTONE BALL MILLS
15	LIMESTONE SLURRY STORAGE TANKS
16	LIMESTONE SLURRY PUMPS
17	GYPSUM DEWATERING BUILDING
18	SECONDARY HYDRO CYCLONE FEED TANK
19	PRIMARY HYDRO CYCLONE FEED TANK
20	WASTE WATER TANK
21	PROCESS WATER TANKS
22	FILTRATE TANK
23	TRUCK UNLOADER RAMP
24	TRUCK UNLOADER
25	LIMESTONE BELT CONVEYER LBC-1A/1B
26	LIMESTONE STORAGE SILDS - A&B
27	LIMESTONE BUCKET ELEVATOR BE-1&2
28	LIMESTONE CRUSHER HOUSE (LC4)
29	LIMESTONE BUCKET ELEVATOR BE-3&4
30	WEIGH BRIDGE FOR LIMESTONE/GYPSUM HANDLING

LEGEND :	
(K1)	THE EXISTING PLATFORM/PAVING WHICH IS DISMANTLED FOR CONCRETE RAFT HAVE TO RE-LAID UPON CHIMNEY SHELL BY B&E.
FGL	FINISHED GROUND LEVEL
FFL	FINISHED FLOOR LEVEL
BM8	BALL MILL BUILDING
GDWB	GYPSUM DEWATERING BUILDING
FWT	FILTRATE WATER TANK (INSIDE GDWB)
LSST	LIMESTONE SLURRY STORAGE TANK (CREAGENT TANK)
AA1	AUXILIARY ABSORBENT TANK
BUF	BOOST UP FAN
WWT	WASTE WATER TANK
SHT	SECONDARY HYDRO CYCLONE FEED TANK
PKWT	PROCESS WATER TANK
CLWT	CLARIFIED WATER TANK
BFWT	BELT FILTER WATER TANK
PHFT	PRIMARY HYDROCYCLONE FEED TANK
CWT	CASE WASHING TANK
FWT	FILTRATE TANK

SNO	NAME	Size (not to exceed)	Nos
01	ABSOBER	2390mmW X 10900mML	03
02	GDWB	2040mmW X 4500mML	01
03	BMB	2200mmW X 2400mML	01
04	CONTROL ROOM	2400mmW X 8000mML	01
05	ATT	1250mmD X 1380mmH	01
06	PWT	600mmD X 6700mmH	02
07	LSST	1350mmD X 15400mmH	02
08	WWT	700mmD X 8000mmH	
09	PHFT	700mmD x 7500mmH	01
10	SHFT	600mmD X 6200mmH	01

REFER. DRG. Nos:

- 0370-323A-P0C-C-0438 (P/R BEHIND CHIMNEY PLAN)
- 0370-323A-P0C-C-0439 (P/R BEHIND CHIMNEY ELEVATION)
- 0370-323A-P0C-C-0442 (P/R NEAR AHA PLAN)
- 0370-323A-P0C-C-0443 (P/R NEAR AHA ELEVATION)
- 0370-323A-P0C-C-0160 Air compressor house GA
- 0370-323A-P0C-C-0178 Ash water PH GA
- 0370-323A-P0C-C-0224 AH Control room GA
- 0370-323A-P0C-C-0270 ESP Control room GA

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
2. ELEVATION 0.00 CORRESPONDS TO MAIN POWER HOUSE RL(+1) 121.7 M
3. LOCATION/SIZE OF BOP FACILITIES IS TENTATIVE ONLY
4. THE BUILDING AND EQUIPMENT SIZES SHOWN IN THIS DRAWING IS INDICATIVE ONLY AND WILL BE FINALIZED DURING DETAIL ENGINEERING

REV.	DATE	ALTD	CHK	APPS	REV.	DATE	ALTD	CHK	APPS
02	11-2-2020	LOGANATHAN	V M RAD	KUMAR K	01	04/12/19	LOGANATHAN	PAJHI	V V SUND
DUCT ROUTING FOR UNIT-01 & UNIT-02 REVISED AS									

REVISED AS PER NTPC COMMENT:

CUSTOMER NOS:G609, G610, G611

P/NO	NTPC DRAWING NO : 0370-109-PVM-F-044
	CUSTOMER: NTPC LIMITED.
	PROJECT: NABINAGAR SUPER THERMAL POWER PROJECT (3X660MW)

 SHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER ACCESSORIES PLANT, PANIPET-632 406.	DEPT	NAME	SIGN	
	CODE	DRN	LOGANATHAN	-66-
	M	CHD	PADHI	-3d-
		APPD	VV SUNDAR	-6d-

FILE:	LAYOUT OF FGD SYSTEM	SCALE :	
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 RANIPET	Bharat Heavy Electricals Limited Boiler Auxiliaries Plant Ranipet – 632 406	BHEL DOC NO.	PS: NN FGD: : G609
		REVISION NO.	02
		DATE	06.12.2019

NABINAGAR FGD PACKAGE

PAINTING SCHEME for FGD SYSTEM, BOOSTER FAN& GATES& DAMPERS

NTPC CONTRACT NO: CS-0370-109-(1A) -2-FC -NOA-0059

NTPC DRG NO: 0370-109-PVM-H-001

BHEL RANIPET Customer No(s).: G609-G611

Prepared By	Reviewed & Approved By
	
Rajamanickam M Dy.Manager/QA	K.C. G Certification signature by P.S. Chowdhury <pschowdhury@ntpc.co> Validity Unknown P.S. Chowdhury Date: 2019.12.20 09:50:32 IST Reason: CAT I Location: NTPCEOC

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

RECORD OF REVISION

REV NO	DATE	DETAILS OF REVISION
00	25.10.2019	Original Issue - First Submission
01	18.11.2019	NTPC comments: BHEL has got approved painting schedule for other projects with same spec which may please be endorsed. BHEL reply: We wish to submit that we have got approved painting scheme for other projects with same spec but the PGMA's will vary from one project to another depending upon the size and scope. Hence we request you to kindly consider and approve the painting scheme developed for this project.
		NTPC comments: Please include Painting Schedule for Limestone & Gypsum Handling System equipment. BHEL reply: We wish to submit that this painting scheme is intended only for Ranipet scope of supply. The scope of the items referred in the comments are given by ISG group. Painting scheme for ISG scope of supply will be submitted separately by them as their PGMA's are different and paint selection will be different based on the intricacies of their product. Also FGD is a system supplied by seven units of BHEL similar to SG and TG package. Therefore, we request you to kindly consider and approve this painting scheme for Ranipet scope of supply.
02	06.12.2019	NTPC comments: no electrical items like motors, switchgear etc., are covered in this document??? where are they covered? BHEL reply: This painting scheme covers painting for manufacturing items, Electrical items like motors, switchgears etc are bought out items and the painting is covered in the respective drawings itself which are submitted to NTPC for approval. Painting as per NTPC specification is given in the drawings. This is the practice which is followed for SG and TG packages as well. We request you to kindly approve the document.
		NTPC comments: will there be as many documents as the no of units of BHEL? BHEL reply: Other than BAP, Ranipet, separate painting schedule will only be submitted by ISG as the manufacturing items are available for them. Other units cover the painting in the drawing itself which will be submitted to NTPC for approval as they deal with bought out items more. We request you to kindly approve the painting schedule.

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100	Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	25	
6	Booster fan canopy for motor (Clause 1.04.00 of Part- A Section VI)	55 089	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
7	Axial booster fan rotor (Clause 20.03.00 of Part- C Section VI)	55 287	Power Tool Cleaning to St3 (SSPC-SP3)	Two coats of Epoxy based Zinc phosphate primer (Two pack system) to IS 13238; DFT- 30µ/coat	60	NIL	--	60
8	Axial booster fan stator (Clause 20.03.00 of Part- C Section VI)	55 587	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Axial booster fan coupling (Clause 1.04.00 of Part- A Section VI)	55 880	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
10	Booster fan LOS with lubricant (Clause 1.04.00 of Part- A Section VI)	55 980	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
11	Booster fan actuator (Clause 1.04.00 of Part- A Section VI)	55 983	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

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

2. FGD SYSTEM

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

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

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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
10	Emergency Quench water tank- Inside surfaces	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Primer: Two coats of Red Oxide Zinc phosphate primer, DFT-30µ/coat; Total-60µ (Primer is only envisaged as lining is given in inside surfaces of the tank)				
11	Emergency quench system, Handling Equipment RC pump (Clause 20.03.00 of Part- C Section VI)	FW 227 FW 249	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120
12	Air oxidation system, Viewing ports (Without glass) (Clause 20.03.00 of Part- C Section VI)	FW 230 FW 239	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
13	Absorber W/D interface, W/D wash system, Slurry distribution system, Oxidation Air distribution system (Clause 1.04.00 of Part- A Section VI)	FW 228 FW 229 FW 243 FW 244	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)	
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)		
14	Expansion joint between bypass (Clause 20.03.00 of Part- C Section VI)	Flue gas swept surface	FW 251	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats)	60	--	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
15	Expansion joint (Clause 20.03.00 of Part- C Section VI)	Flue gas swept surface	FW 252	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
16	Ducts between bypass duct inlet& booster fan (Clause 20.03.00 of Part- C Section VI)	Flue gas swept surface	FW 255	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
17	Ducts between Booster fan& Absorber (Clause 20.03.00 of Part- C Section VI)	Flue gas swept surface	FW 256	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40

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

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

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

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

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

[illegible]

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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
38	Limestone silo approach platform, Pipe racks, Sub pipe racks platform- Structures other than the above (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
39	Limestone Mill – Outside surfaces (Clause 1.04.00 of Part- A Section VI)	FW 735	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
40	Lime stone mill- Inside surfaces	FW 735	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN ($\mu\text{m min.}$)
				PAINT	DFT ($\mu\text{m min.}$)	PAINT	DFT ($\mu\text{m min.}$)	
41	Gypsum belt filter and accessories Structural items (Clause 1.04.00 of Part- A Section VI)	FW 738	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50 μ /coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100 μ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75 μ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25 μ Shade: Grey White, RAL9002	75 25	300
42	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary hydro cyclone feed tank, Clarified water tank Outside surfaces (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 800 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60 μm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% $\pm$ 2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70 μ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80% $\pm$ 2) DFT- 100 μ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55% $\pm$ 2) DFT- 35 μ / coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0 Δ E)	70	240
43	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydrocyclone waste water tank, Neutralization tank,	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50 μm	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) (Liner is inside the tank, hence primer is only envisaged; Protection till erection only)	60	NIL	--	60

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

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

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

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

3. GATES & DAMPERS

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

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

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

4. PAINTING OF DAMAGED AREAS

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

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

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

GENERAL NOTES

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

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

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

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

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

PGMA DETAILS

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

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

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

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

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
20	FW 310	Structures for booster fan handling	Columns Beams Bracings Seal plate
21	FW 610 FW 722	Galleries & railings for Scrubbers, Tank	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
22	FW 701	Slurry pumps & accessories	Slurry Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Expansion Bellow Anchor Bolts & Fasteners Motor & accessories Sump Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Anchor Bolts & Fasteners Motor & accessories
23	FW 710	Monorail for hoist& cranes	Insert Plate Stiffener plate Monorail beam
24	FW 721	Agitator support	Channels & Beams
25	FW 730	Limestone silo structures	Columns Beams Bracings Seal plate Angles, channels

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

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
26	FW 731	Limestone silo	Base plate & its supports Shell, Roof
27	FW 723 FW 724 FW 725	Air cannon Bag filter Nozzles & flanges	Bag filter Air cannon bin activator Nozzles & Flanges
28	FW 733	Limestone silo approach platforms	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
29	FW 734	Limestone mill	Wet ball mill Hydro cyclone- Mill area Mill circuit pump Mill separator tank with Agitator
30	FW 742	Lime stone slurry storage tank	Base plate & its supports Shell, Roof
31	FW 743	Auxiliary Absorber tank	Base plate & its supports Shell, Roof
32	FW 744	Filtrate tank	Base plate & its supports Shell, Roof
33	FW 745	Wastage water tank	Base plate & its supports Shell, Roof
34	FW 747	Hydro cyclone waste water tank	Base plate & its supports Shell, Roof
35	FW 748 FW 785 FW 786	Process Water tank Belt filter washing tank Primary Hydro cyclone feed tank	Base plate & its supports Shell, Roof
36	FW 751 FW 752	Process water pipe accessories Cooling water pipe accessories	CS/FRP Pipes & Fittings Sight Glass R Orifice Gaskets & Fasteners
37	FW 753	Slurry pipe accessories	CSRL/FRP Pipes & Fittings Strainer (Cone) Expansion Joint-Rubber R Orifice Gaskets & Fasteners

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

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
38	FW 754	Service air pipe accessories	GI Pipes & Fittings Flexible Hose Expansion Joint (Metallic) Hose connector R Orifice Gaskets & Fasteners
39	FW 755	Instrument air pipe accessories	SS Pipes & Fittings Strainer(Y Type) Gaskets & Fasteners
40	FW 815 to FW 851	Valves and fittings	Globe valves Ball Valves Butterfly Valves Diaphragm Valves Gate Valves CheckValves Pinch Valves Knife Gate Valves Control Valves Relief Valves
41	FW 761 FW 765	Structures for Pipe racks Structures for Sub pipe racks	Bracings Columns
42	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 763	Foundation material for duct structure Foundation material for absorber Foundation material for Tanks Foundation material for Pipe racks Foundation material for Elevator Foundation material for RC pump shed	Foundation bolts Template
43	FW 766	Platforms for Pipe rack	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
44	FW 768 FW 769	Trestle for Main & sub Pipe racks	Truss Beams, Supports for all Pipes
45	FW 779	Supports for cable tray	Double Sup Channel & Base plates Single Sup Channel & Base plates

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

			Cantilever Arm Fasteners & clamps Brackets
46	FW 996	Tools	Erection , commissioning, special tools
SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
47	FW 798	Air receivers	Instrument Air receivers Any Instruments/Valves
48	FW 800	Clarified water tank	Base plate & its supports Shell, Roof
49	FW 802	Neutralization tank & accessories	Base plate & its supports Shell, Roof
50	FW 988 FW 997 FW 999	Commissioning spares & Mandatory spares	Startup & commissioning spares Mandatory spares



**3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-457-571-A001

SECTION : I

SUB-SECTION : D

REV 00

SHEET 1 OF 6

SECTION-I

SUB-SECTION-D

ANNEXURE-V

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**

Primary Documents Marked ()**



3x660 MW NABINAGAR STPP
GYPHUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION

SPECIFICATION No: PE-TS-457-571-A001
SECTION : I
SUB-SECTION : D
REV 00
SHEET 2 OF 6

Drawings/Drawings to be submitted by the bidder

Sl.No.	Document required after award of contract	No. of hard copies after award of contract	Submission time*
1.	Drawing Schedule	6	2
2.	Plot Plan & Layout	6	2
3.	Process Flow Diagram (**)	6	2
4.	Equipment List	6	2
5.	Utility Consumption	6	2
6.	Chemical List	6	2
7.	Duly filled technical datasheet (**)	6	2
8.	P & I Diagram (**)	6	2
9.	Performance Test Procedure & Report	6	8
10.	Outline Drawing of Equipments (**)	6	6
11.	Fabrication Drawing of Equipments	6	8
12.	Warranted Performance curve of Machinery	6	6
13.	Platform Drawing	6	6
14.	Line Index	6	6
15.	Piping Material Specification	6	6
16.	Piping Arrangement Drawing (**)	6	6
17.	Piping Support Arrangement Drawing	6	6
18.	Isometric Drawings	6	4
19.	Data sheet of Piping Parts	6	6
20.	Valve Drawing	6	8



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION

SPECIFICATION No: PE-TS-457-571-A001

SECTION : I

SUB-SECTION : D

REV 00

SHEET 3 OF 6

21.	Instrument Schedule List	6	8
22.	Instrument Function Loop Diagram	6	8
23.	Interlock and Operation Description	6	8
24.	Interlock/ Sequence Logic Diagram	6	8
25.	Instrument Power Supply Diagram	6	8
26.	Instrument Set Point List	6	8
27.	Instrument Data Sheet	6	8
28.	Valve Data Sheet, including On-Off Valve	6	8
29.	Nozzle Elevation Plan for Level Instrument	6	8
30.	Specification and Drawing of Instrument	6	8
31.	Instruction Manual for Instrument	6	12
32.	Local Control Panel Specification	6	8
33.	Local Control Panel Drawing	6	8
34.	Cable Duct/Tray Routing Plan	6	8
35.	Fabrication Drawing for Cabinet Duct/Tray	6	8
36.	Plot Plan of Field Instrument	6	8
37.	Layout of Instrument Wiring	6	8
38.	Layout of Instrument Air Supply Piping and Signal tubing	6	8
39.	Hook-up Drawing for Instrument	6	8
40.	Instrument Connection List	6	8
41.	Instrument Cable Schedule	6	8
42.	Parts Drawing for Instrument Installation Materials	6	8
43.	Calculation Sheet for Flow Instrument	6	8



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION

SPECIFICATION No: PE-TS-457-571-A001
SECTION : I
SUB-SECTION : D
REV 00
SHEET 4 OF 6

44.	Motor List (**)	6	8
45.	Motor Data Sheet (**)	6	8
46.	Outline drawing of Motors (**)	6	8
47.	Electrical Loading Data	6	8
48.	Drawing of Foundation of Equipment(s)	6	6
49.	Painting Specification	6	10
50.	Sub-Vendor List (**)	6	4
51.	Detail drawings indicating the dimensions of the equipments.	6	6
52.	Detail drawings indicating the piping layouts	6	6
53.	Detail drawing of Gypsum dewatering building (**)	6	6
54.	Erection drawings	6	8
55.	Operation & Maintenance (O&M) Manual	6	12
56.	Civil Loading details (**)	6	4

General Document(s) to be submitted by Bidder

Sl.No.	Document required after award of contract	No. of hard copies after award of contract	Submission time*
1.	Manufacturing Schedule	6	4
2.	Quality plan & Safety Requirement (**)	6	4
3.	Supply Item List for Package Verification at Site	6	12
4.	Packing List	6	12
5.	Transportation and Storage Specification	6	10
6.	Shop Inspection Specification	6	10
7.	Shop Inspection Report	6	12



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION

SPECIFICATION No: PE-TS-457-571-A001
SECTION : I
SUB-SECTION : D
REV 00
SHEET 5 OF 6

8.	Site Inspection Specification	6	12
9.	Site Inspection Report	6	14
10.	Progress Report	6	4
11.	Consumable Parts List	6	6
12.	Lubricant List	6	6
13.	Special Tool List	6	6
14.	Spare Parts List for Erection	6	6
15.	Spare Parts List for Commissioning	6	8
16.	Spare Parts List for 2 years of Operation	6	8
17.	Construction Work Specification	6	10
18.	Construction Manual List	6	10

***Within No. of Weeks after the placement of LOI/PO**

**** The drawings marked (**) in the list may be considered as Primary.**

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:
 - a) All drawings and documents shall indicate the list of all reference drawings including General Arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross-section, skin section, blow-up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

	3x660 MW NABINAGAR STPP GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-457-571-A001	
		SECTION : I	
		SUB-SECTION : D	
		REV 00	
		SHEET 6 OF 6	
d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc. e) Drawings/ documents to be submitted for purchaser’s review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer’s approval after purchaser’s approval shall be under R-0, 1, 2, 3 etc. f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication. g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity. h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. Documents marked for submission to BHEL’s Customer shall also bear BHEL's Customer’s drawing No. i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL’s/ Customer’s/ Consultant’s office for across the table resolution of issues and to get documents approved in the stipulated time. j) Bidder to follow the following the drawing submission schedule: k) 1st submission of drawings from date of LOI as per the submission schedule. l) Every revised submission incorporating comments – within 7 days. m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder’s account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.			



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

PACKING PROCEDURE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 1 OF 4

SECTION-I

SUB-SECTION-D

ANNEXURE-VI

PACKING PROCEDURE



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

PACKING PROCEDURE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 2 OF 4

1.0	PACKING AND FORWARDING
1.	Proper packing to be ensured. Indigenous Supply: Gypsum Dewatering System & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the pump internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure-VII of this sub-section. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4.	The entire system has to be supplied in containers and it should be suitable for storing in the outer yard of the plant for a minimum period of 12 months. Crates and packing material used for shipping will become the property of owner (NPGCL).
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: - Destination - Package Number - Gross and Net Weight - Dimensions - Lifting places - Handling marks and the following delivery marking

	3x660 MW NABINAGAR STPP		SPECIFICATION No: PE-TS-457-571-A101	
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION		SECTION : I	
			SUB-SECTION : D	
			REV 00	
	PACKING PROCEDURE		SHEET 3 OF 4	

8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides with the DETAILED SHIPPING ADDRESS –TO BE PROVIDED LATER. In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care” , “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks).
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15.	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of pump & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very severe” during final finishing/shipping.
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks.



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

PACKING PROCEDURE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

SHEET 4 OF 4

	Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted to Purchaser within 10 days of placement of the LOI.
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.

BIDDER TO REFER SUB-SECTION C2-A FOR CUSTOMER SPECIFICATION IN THIS REGARD.

SPECIFICATION No: PE-TS-457-571-A101

SECTION : I

SUB-SECTION : D

REV 00

Annexure VII - Seaworthy Packing Specification

**TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001



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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 1	OF 52

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 2	OF 52

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves **VENDOR** of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support **GOODS** during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the **GOODS** to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the **GOODS** during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When **VENDOR** do not have packing capabilities/facilities of their own and therefore intends to sub-contract, **VENDOR** have to inform **BHEL/Purchaser** of the name and address of proposed **PACKER(s)** for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the **GOODS** have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If **VENDOR** has any doubt about the correct method of protection or packing, he should contact **BHEL/Purchaser** in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 3	OF 52

7.0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 4	OF 52

7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:

Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 5	OF 52

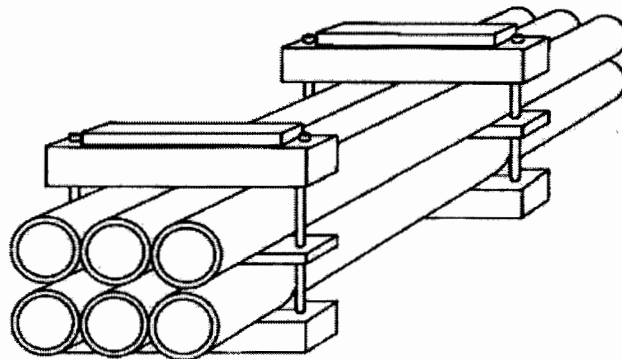
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

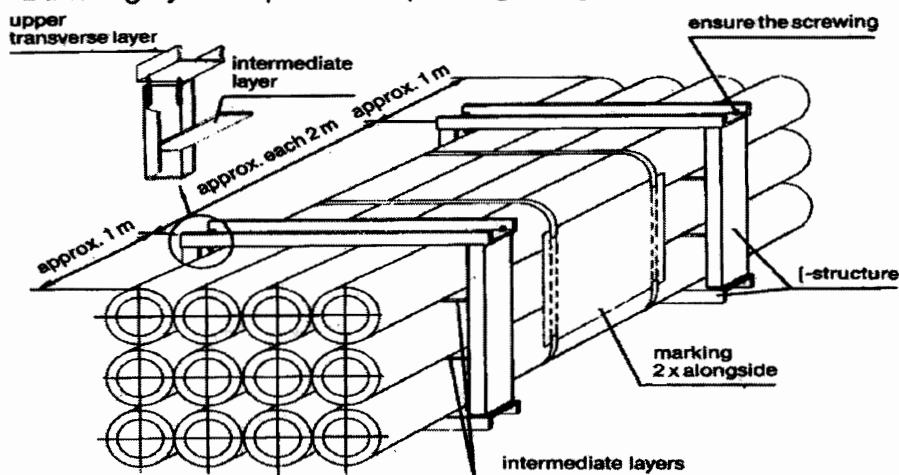
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 6	OF 52

- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

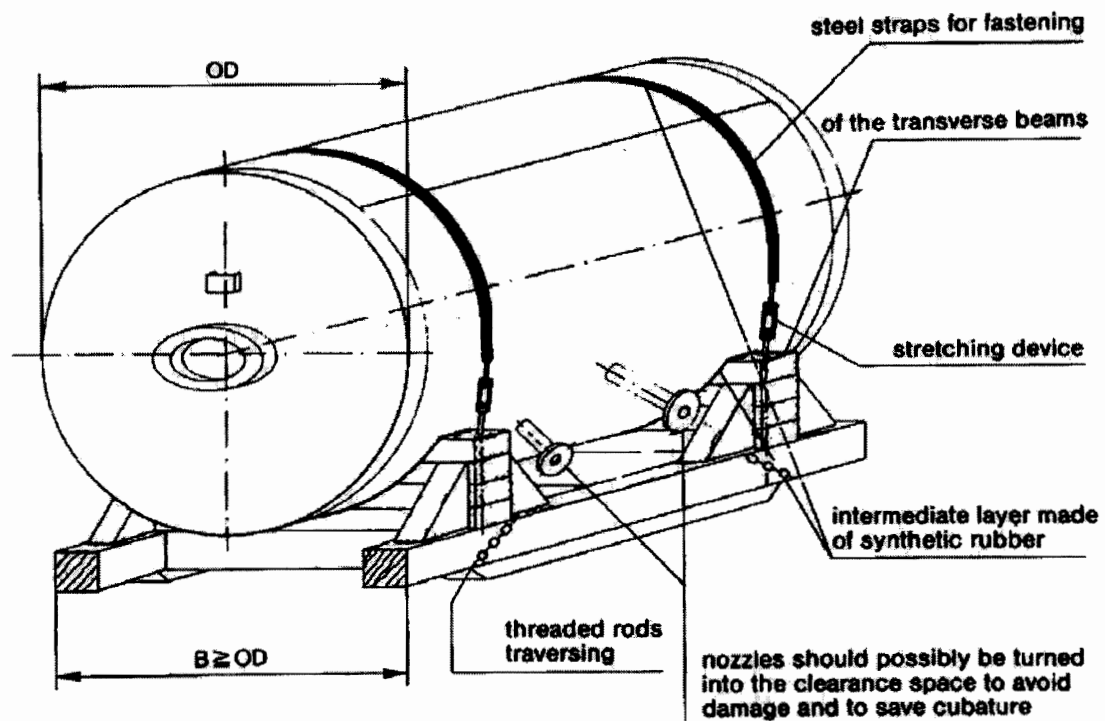
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 7	OF 52

8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

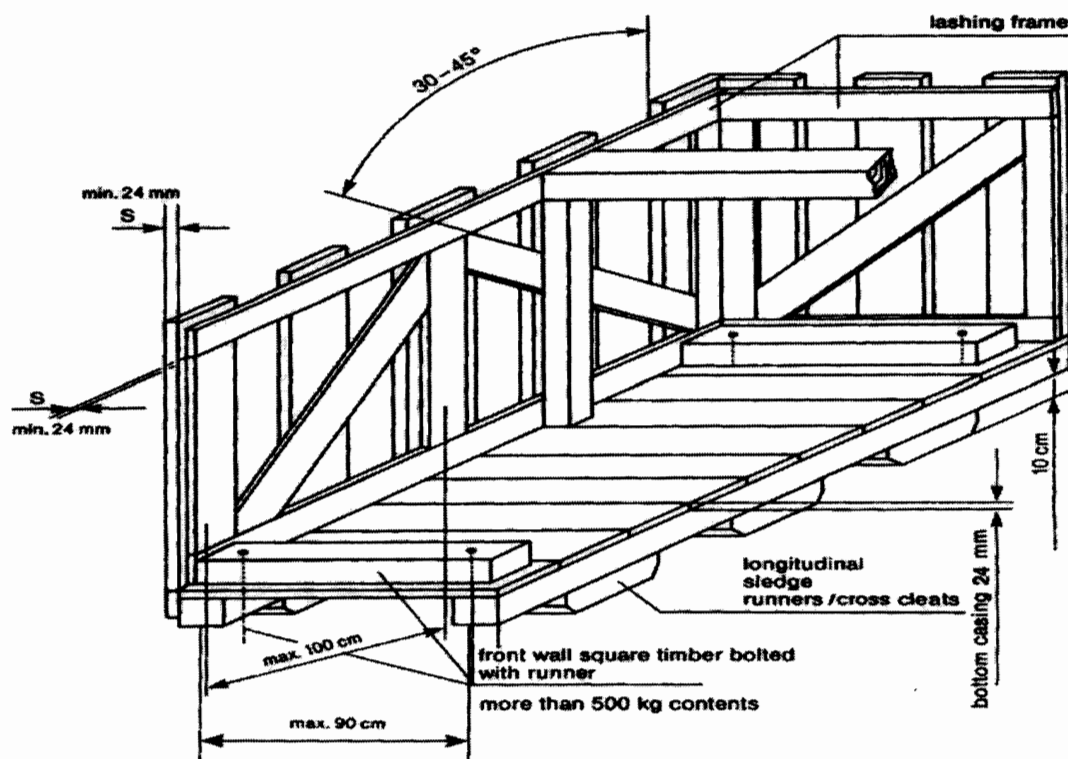
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 8	OF 52

8.4.2 Cases with Lining – Packing Category IV

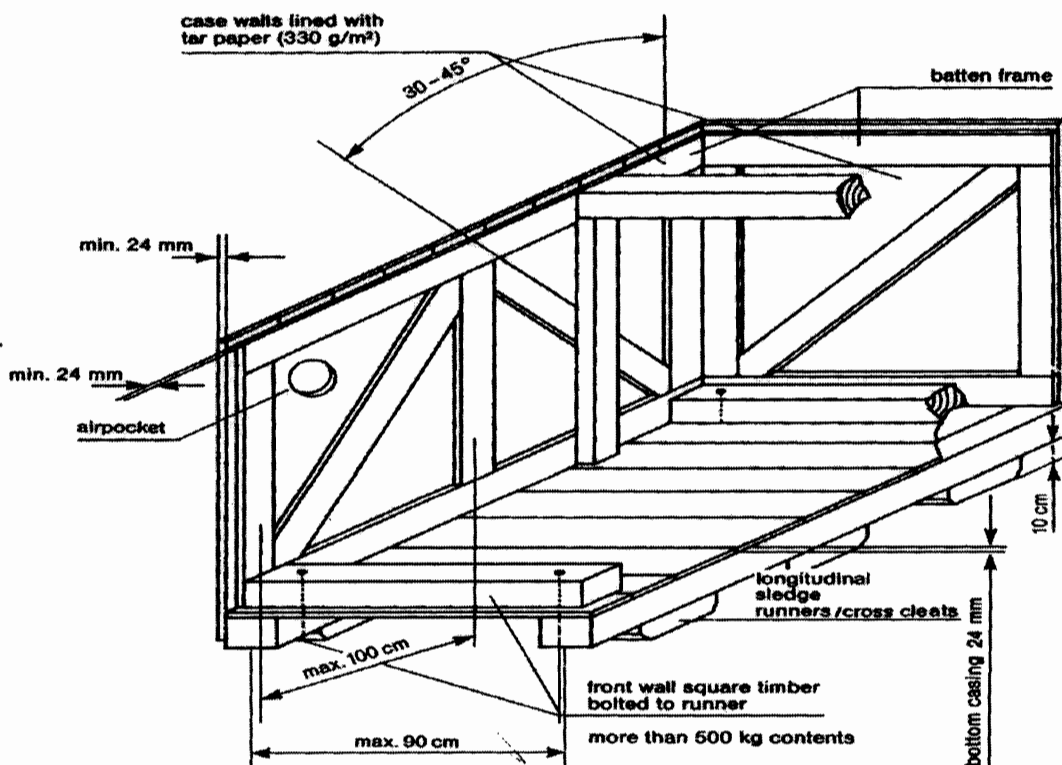
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

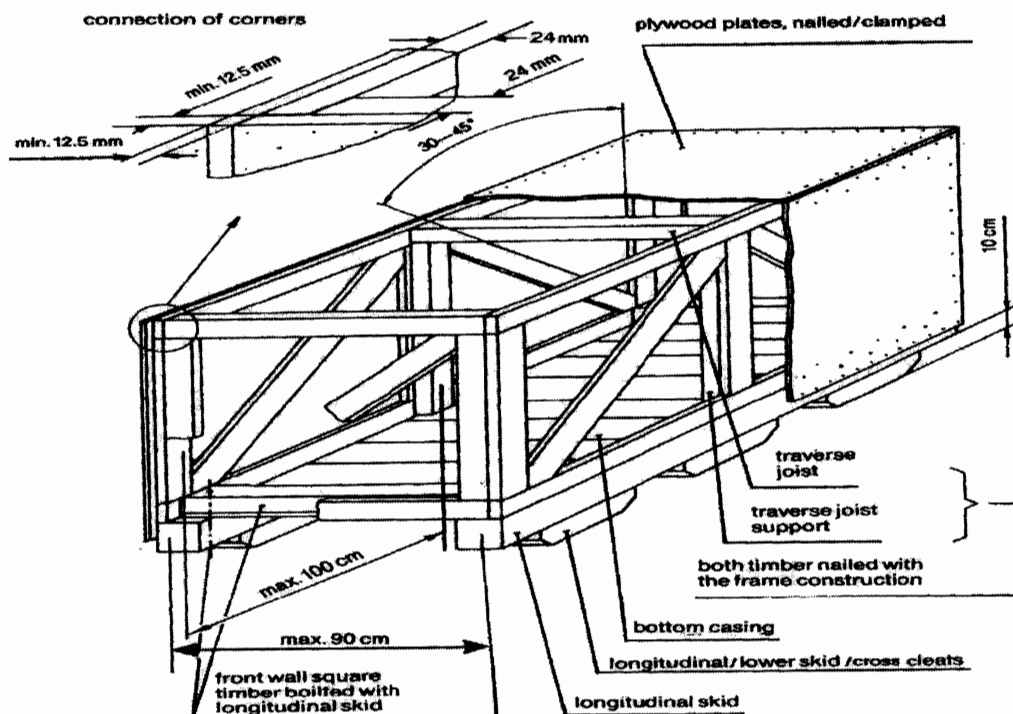
Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 9	OF 52



Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 10	OF 52

Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

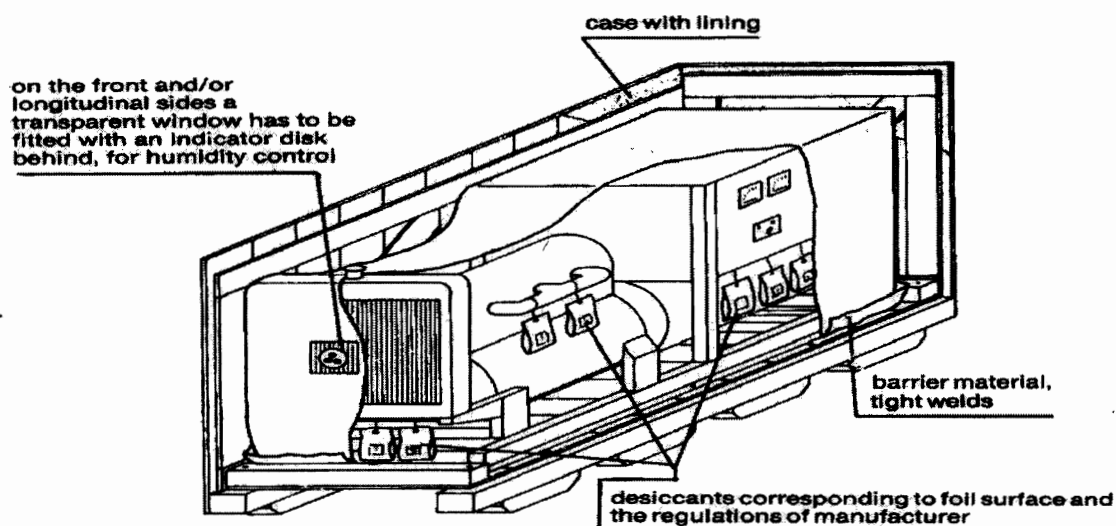
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 11	OF 52

8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001		
		VOLUME II B		
		SECTION D		
		REV. NO. 0	DATE 10/08/2010	
		SHEET 12	OF	52

8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
 - Wooden/cardboard packing cases.
 - Plywood cases.
- Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 13	OF 52

The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 Sling Plate

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 14	OF 52

shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.



TITLE

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

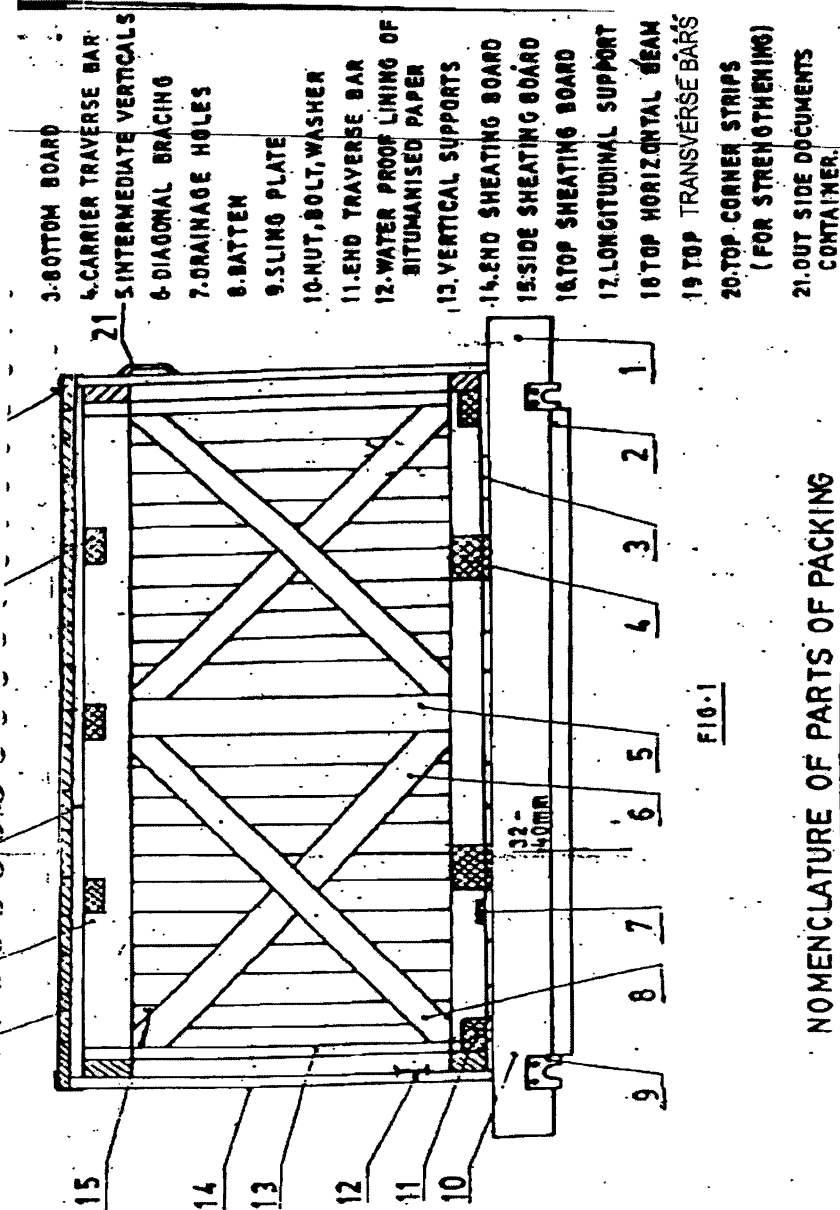
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 15 OF 52



NOMENCLATURE OF PARTS OF PACKING

CASES

FIG-1

EC-009



TITLE

TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 16 OF 52

BOTTOM FRAME ARRANGEMENTS

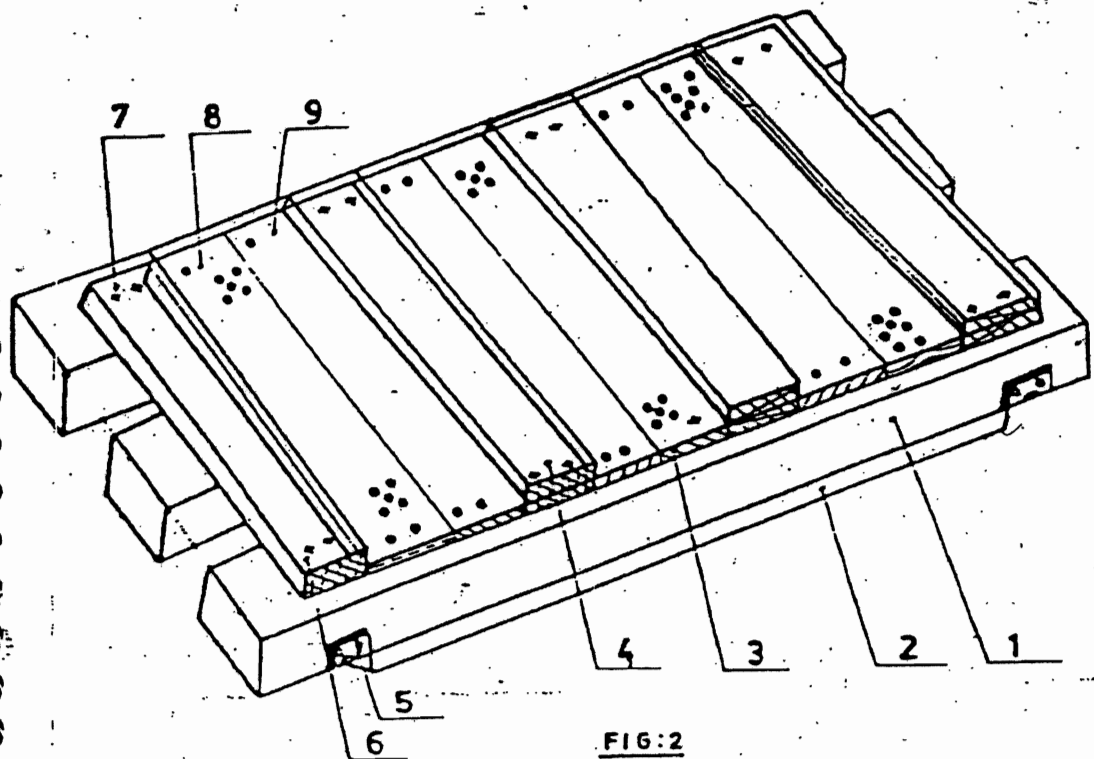


FIG:2

Nos. of slides: Minimum 2 Nos.
For length more than 1800 mm or
load more than 1000kg, Nos. of
slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end traverse bar; 100 x 100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

027



TITLE

TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 17 OF 52

TOP FRAME ARRANGEMENT

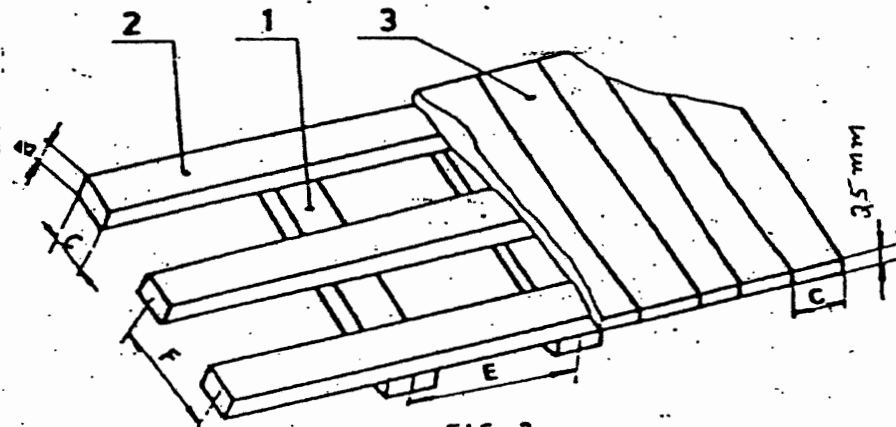
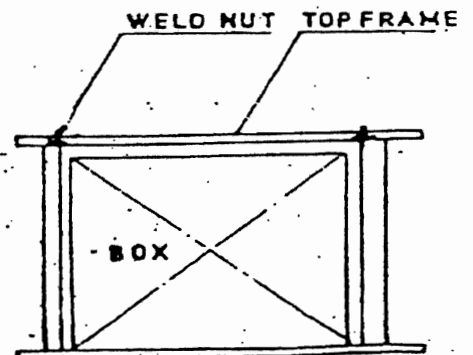
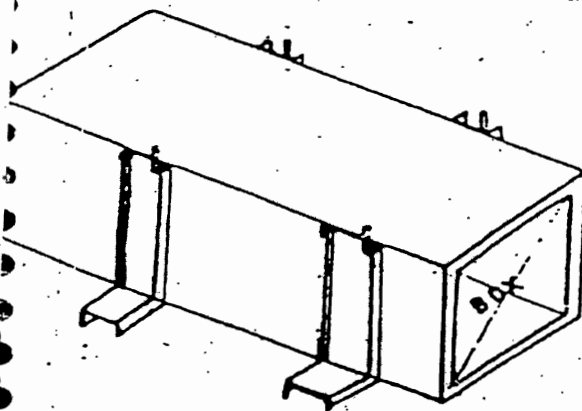


FIG-3

F : 700 to 1000 mm
E : 500 to 900 mm
30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



628

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 18 OF 52

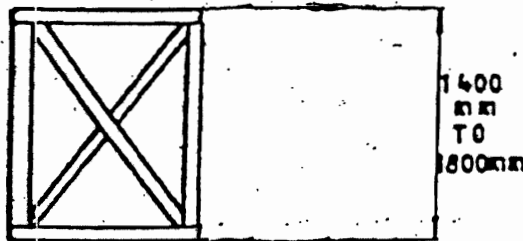
**ARRANGEMENT OF DIAGONAL BRACING AND
HORIZONTAL SUPPORT**

FIG: 6

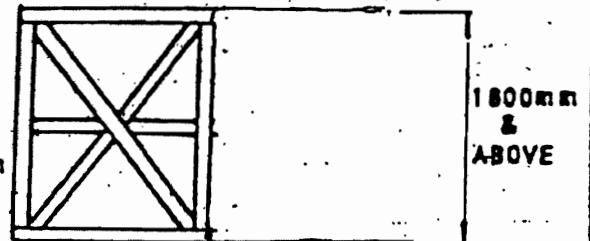


FIG: 8

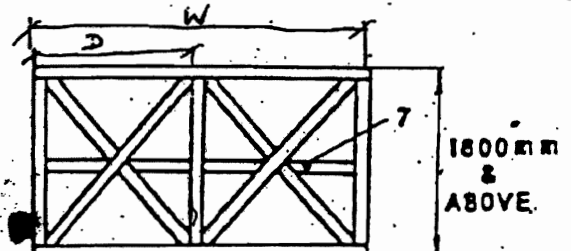


FIG: 7

7- Middle Horizontal Support

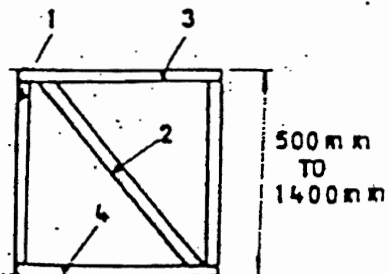


FIG: 5

1- Vertical Support

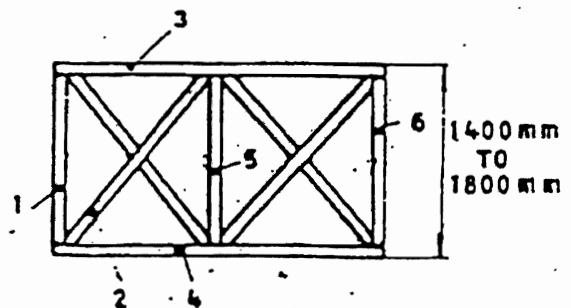


FIG: 7

1, 5, 6 - Vertical Support

029

**TITLE**

**TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001

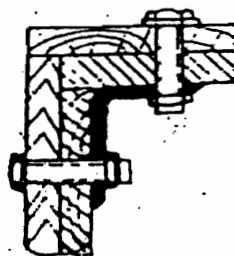
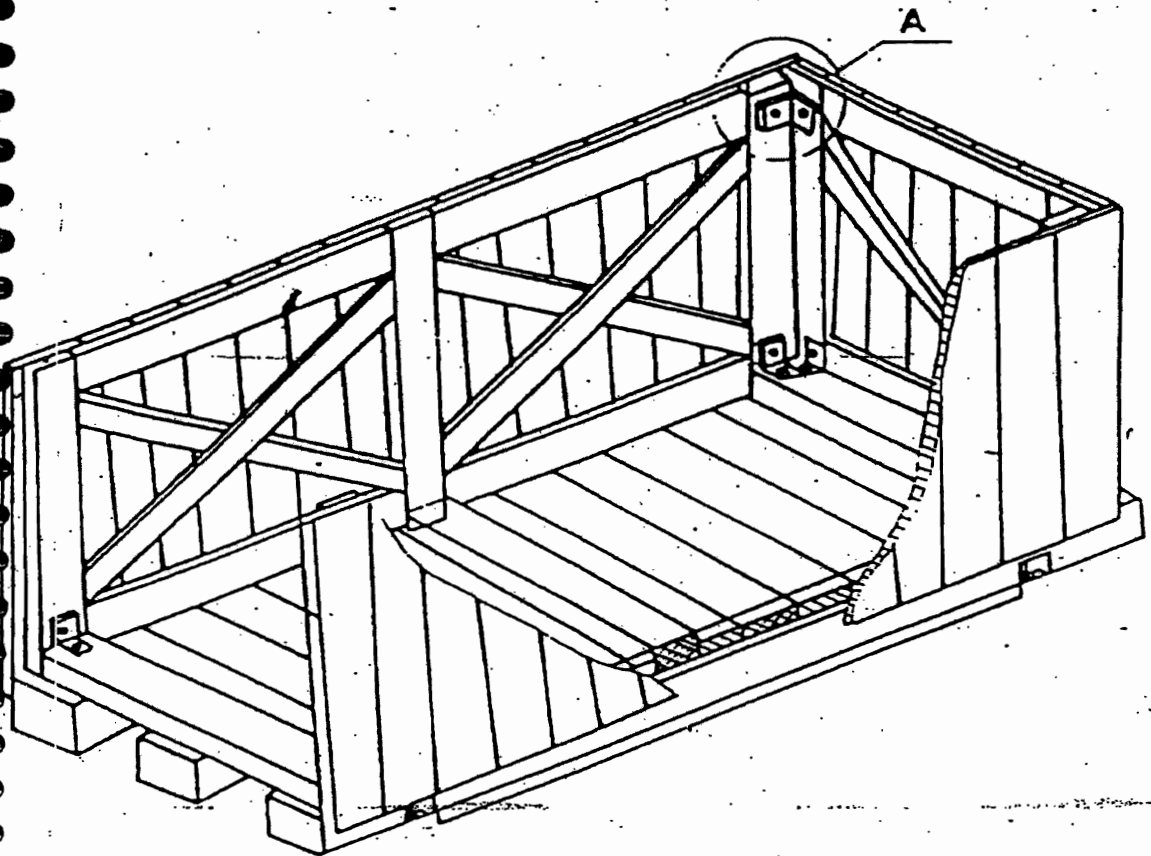
VOLUME II B

SECTION D

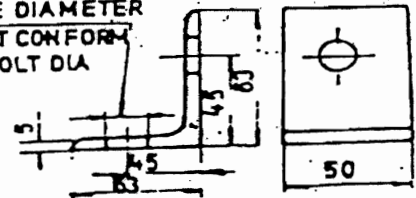
REV. NO. 0 DATE 10/08/2010

SHEET 19 OF 52

ARRANGEMENT OF PACKING CASE

**DETAIL-A**

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

**FIG:10**

030

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

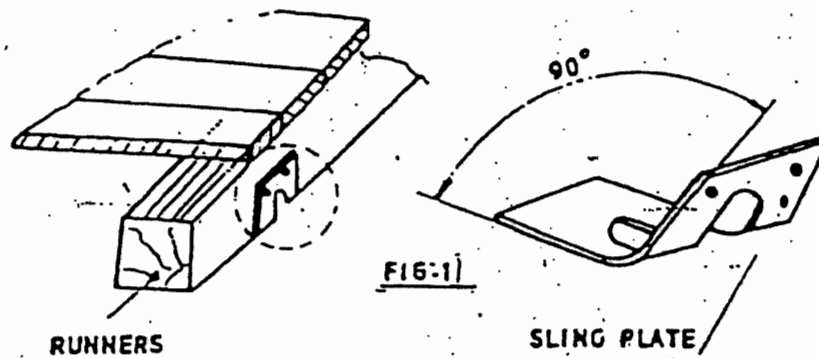
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 20 OF 52

**ARRANGEMENT OF SLING & PLATE ON
CASES**

031

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 21	OF 52

TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				c b		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 22	OF 52

Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 23	OF 52

INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 24	OF 52

Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 25	OF 52

Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

	TITLE		SPECIFICATION NO. PE-TS-888-100-A001	
			VOLUME II B	
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS		SECTION D	
			REV. NO. 0	DATE 10/08/2010
			SHEET 26	OF 52

BHEL-PEM-DEWHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 27	OF 52

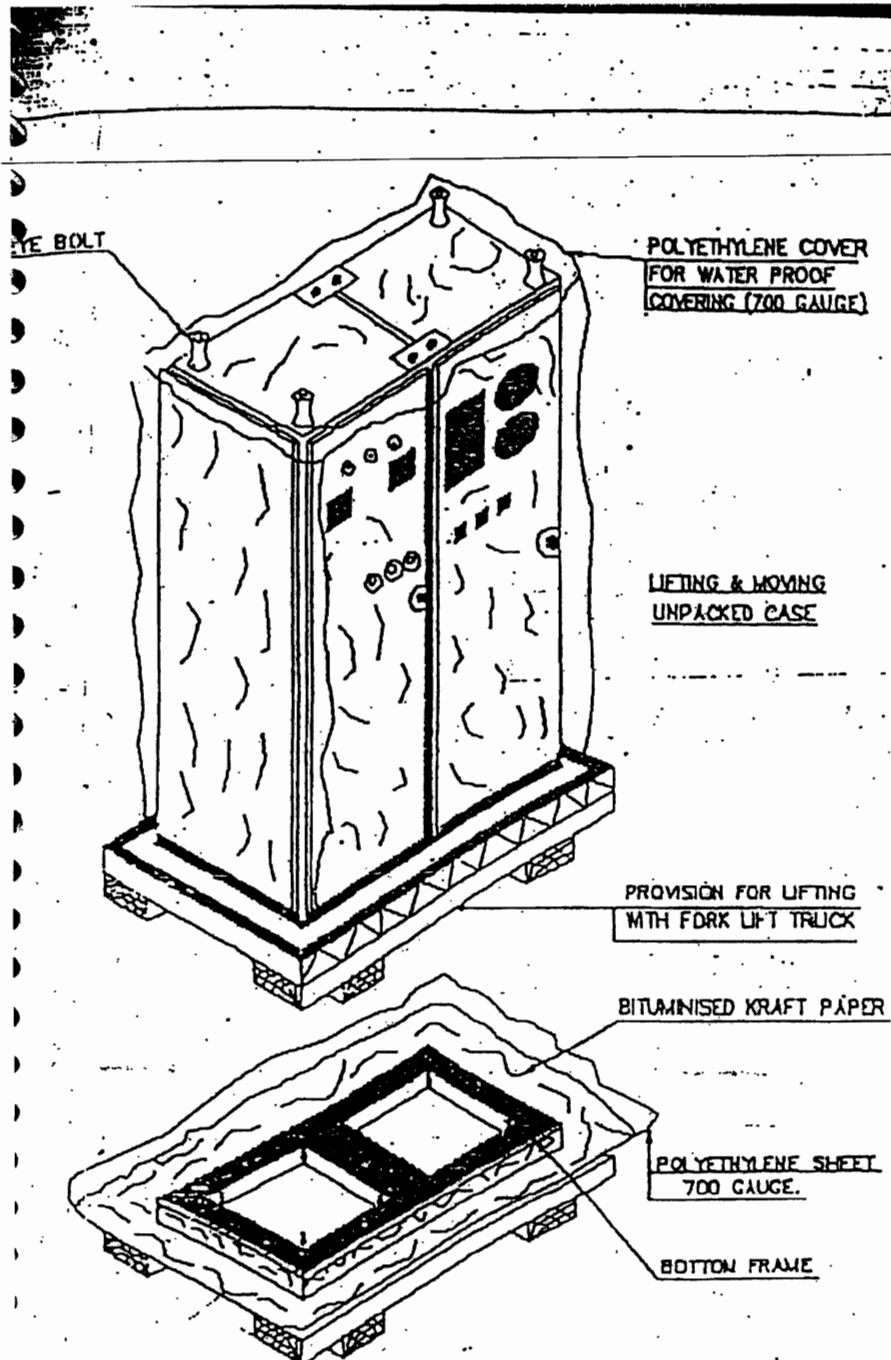


FIGURE-14



TITLE

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 28 OF 52

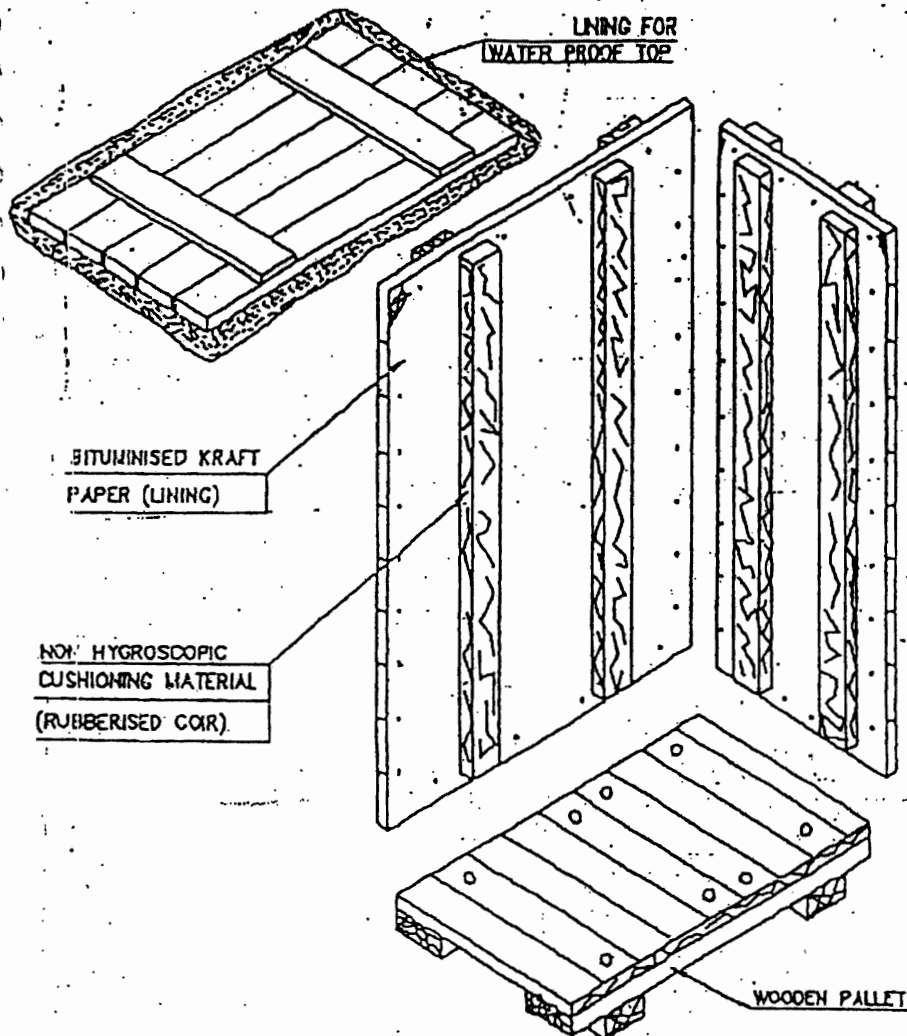
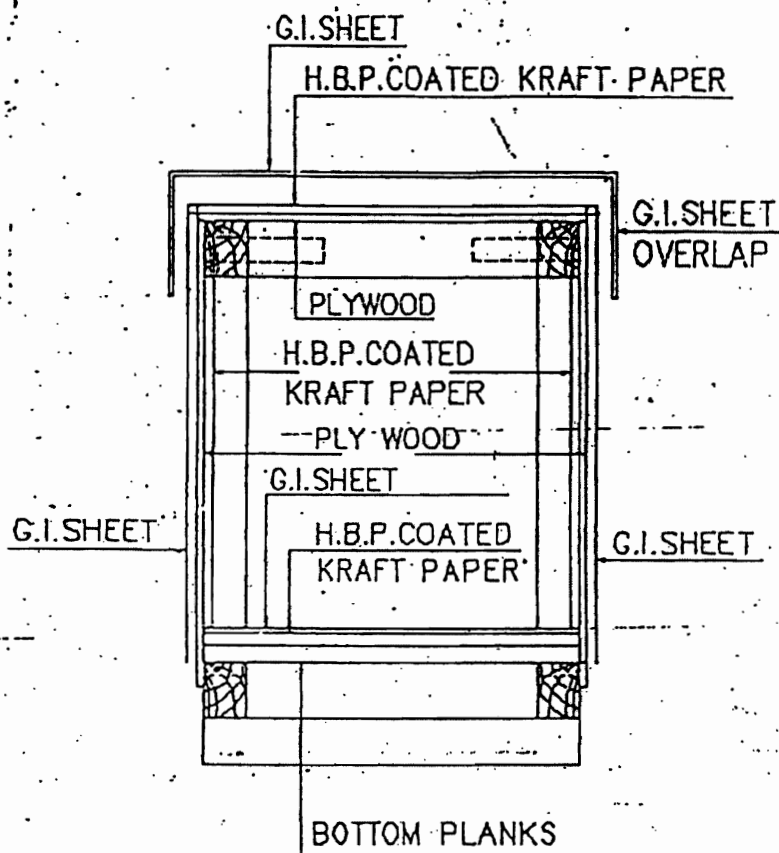


FIGURE-15

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 29	OF 52



**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.**

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 30	OF 52

10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- Project Name
- Purchase Order No.
- Sl. No. of package
- Size of mattress (Thickness x Length x Width)
- Density
- Wire netting material and size
- Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

- Strapping of coil with polyester strap around circumference at one place.
- Putting paper I. D. Edge protector.
- Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- Wrapping the coil with HDPE film.
- Covering the coil including its build up & bore with masonite / particle board.
- Putting metallic I. D on coil.
- Putting O.D edge protector (paper) on coil.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 31	OF 52

- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

- a. Strapping of coil with polyester strap around circumference at one place.
 - b. Putting paper I. D. Edge protector.
 - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
 - d. Wrapping the coil with HDPE film.
 - e. Covering the coil including its build up & bore with masonite / particle board.
 - f. Putting metallic I. D on coil.
 - g. Putting O.D edge protector (paper) on coil.
 - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
 - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
 - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

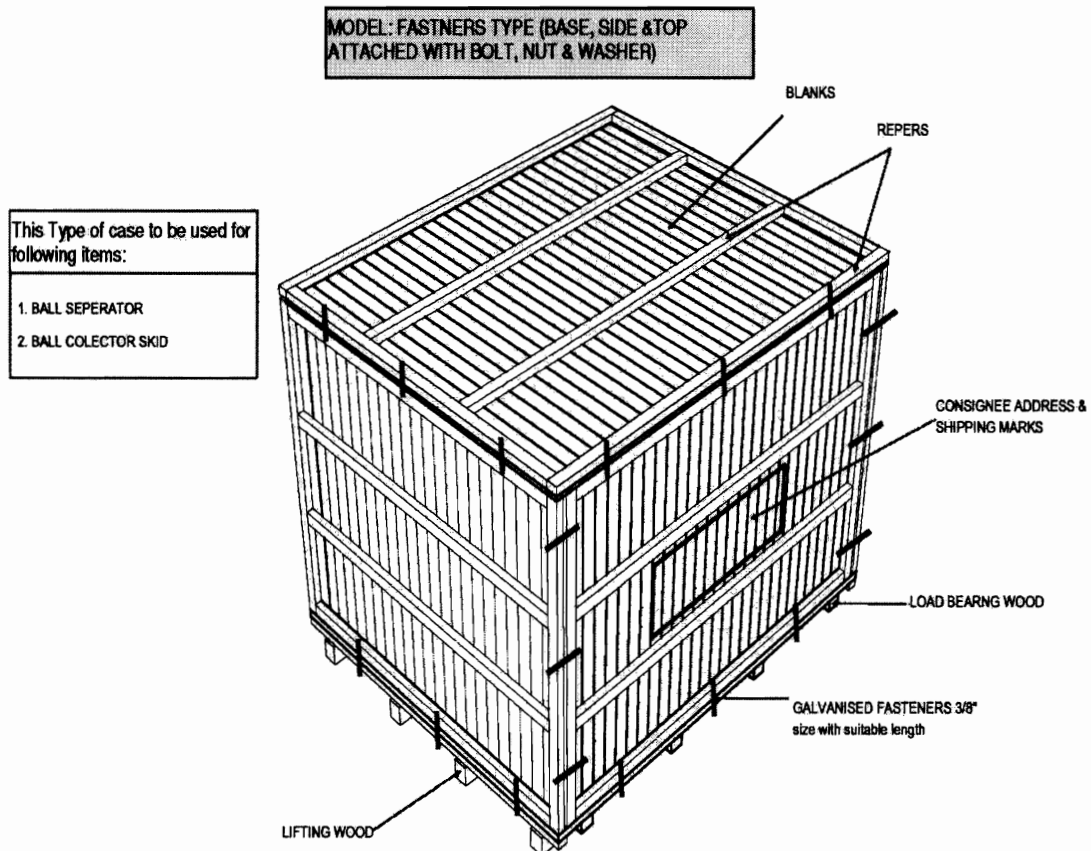
10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	32 OF 52

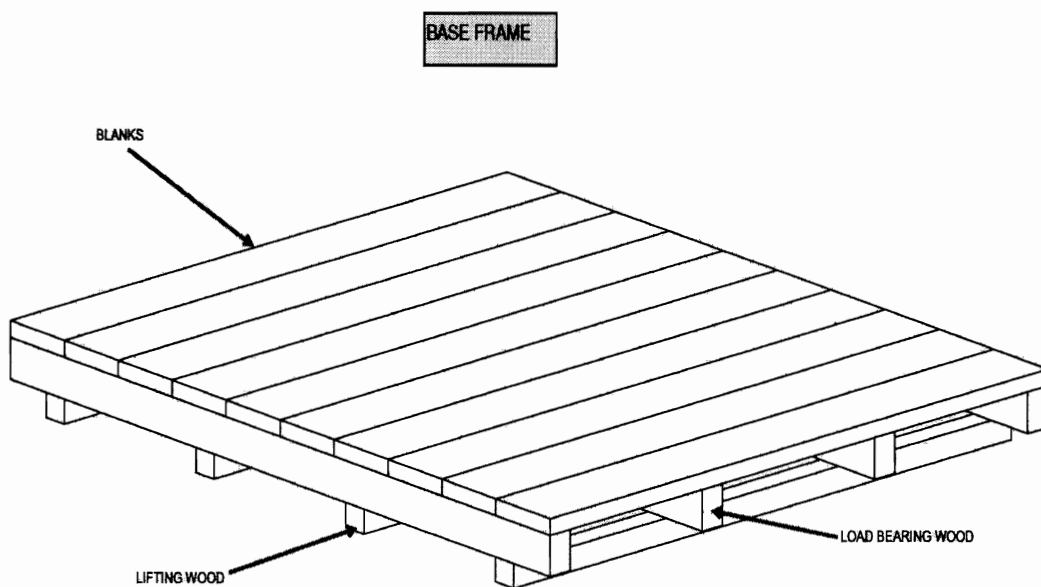
- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 33	OF 52



SHEET 05 of 10

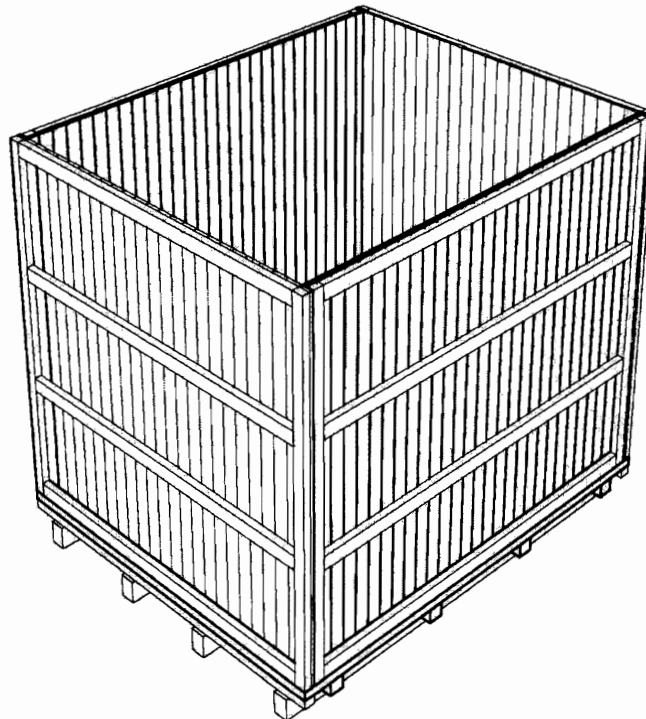
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 34	OF 52



SHEET 06 of 10

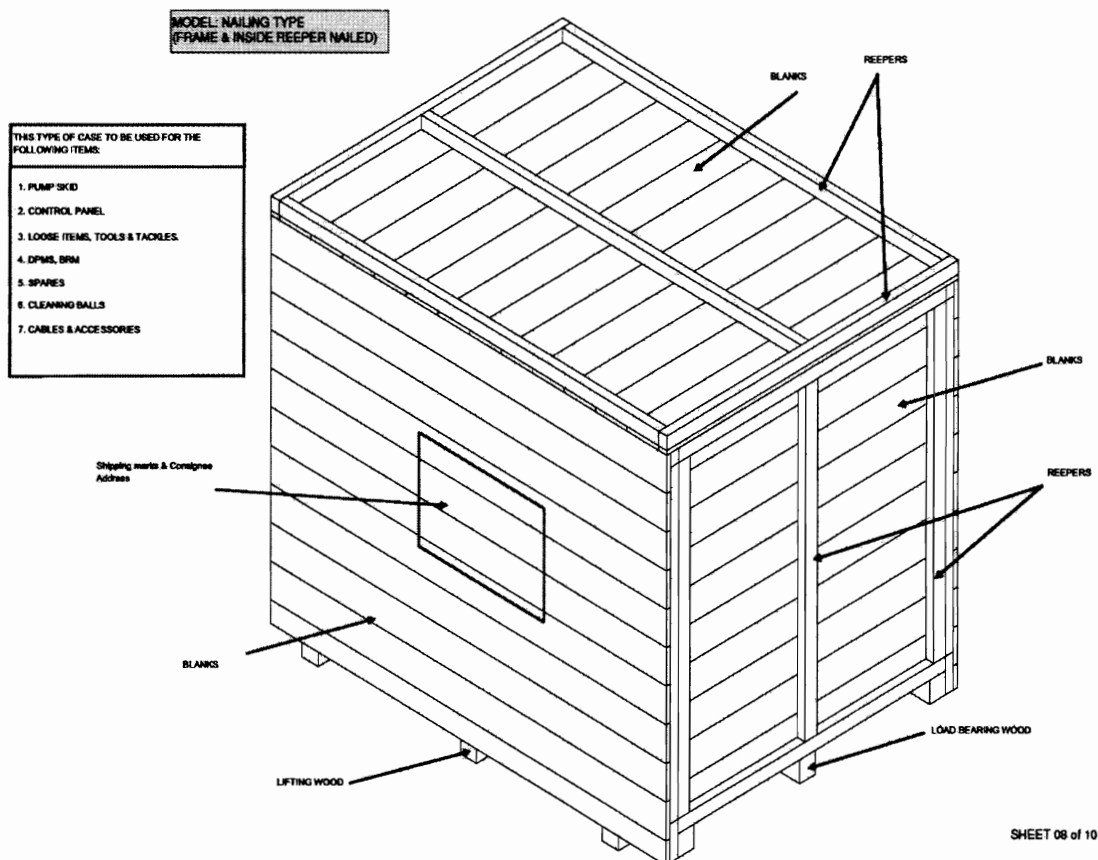
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 35	OF 52

MODEL: FASTNERS TYPE - WITHOUT TOP



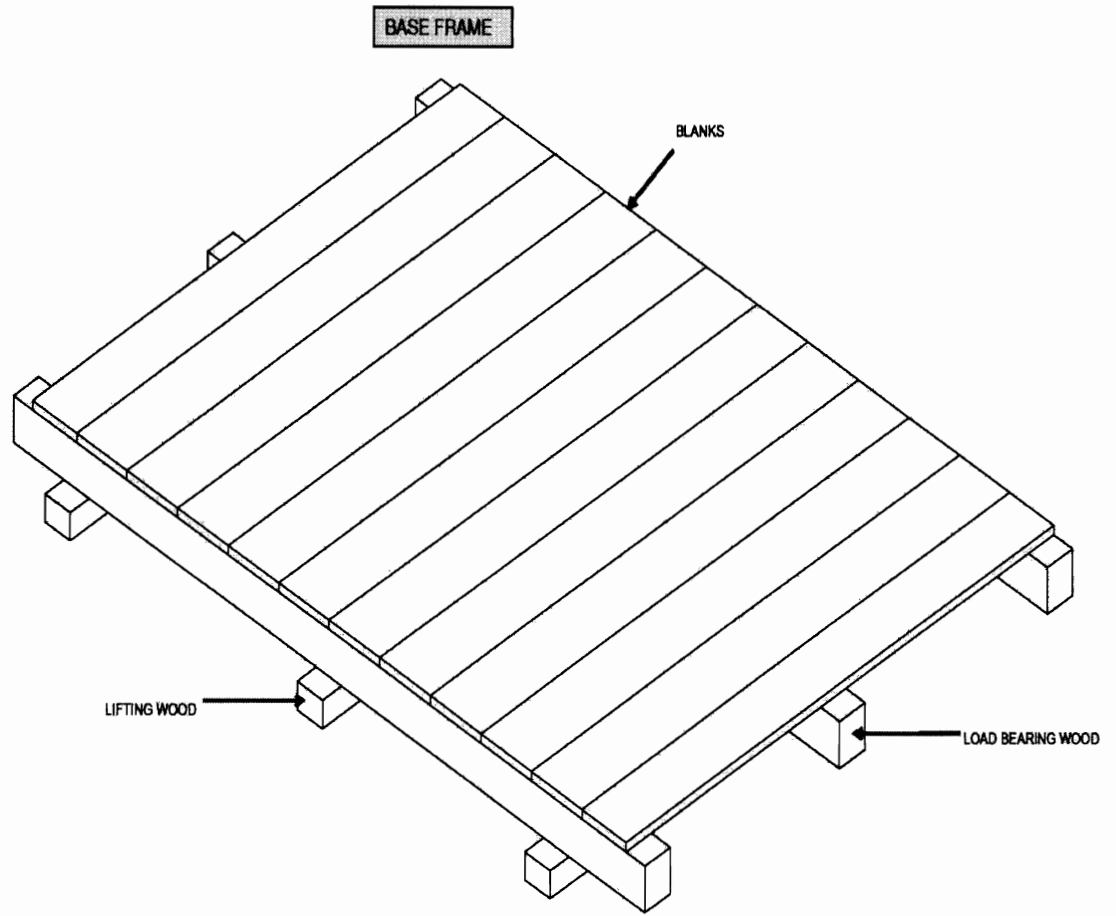
SHEET 07 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 36	OF 52



SHEET 08 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 37	OF 52



SHEET 09 of 10

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**SPECIFICATION NO. **PE-TS-888-100-A001**

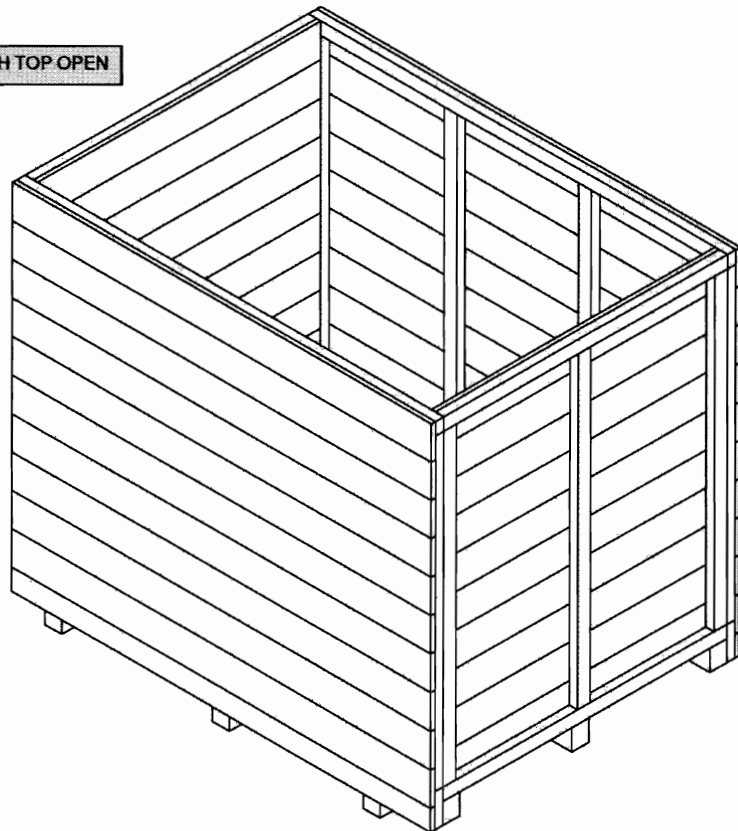
VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 38 OF 52

NAILING TYPE MODEL WITH TOP OPEN



SHEET 10 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 39	OF 52

10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

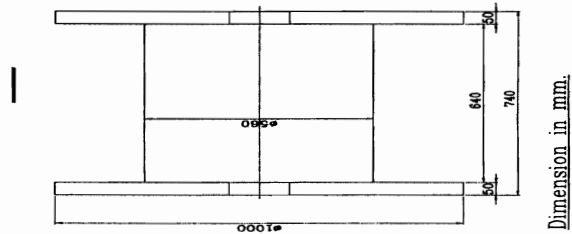
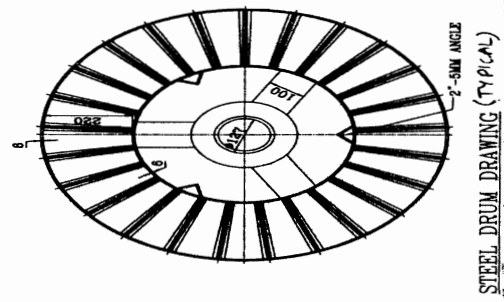
11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

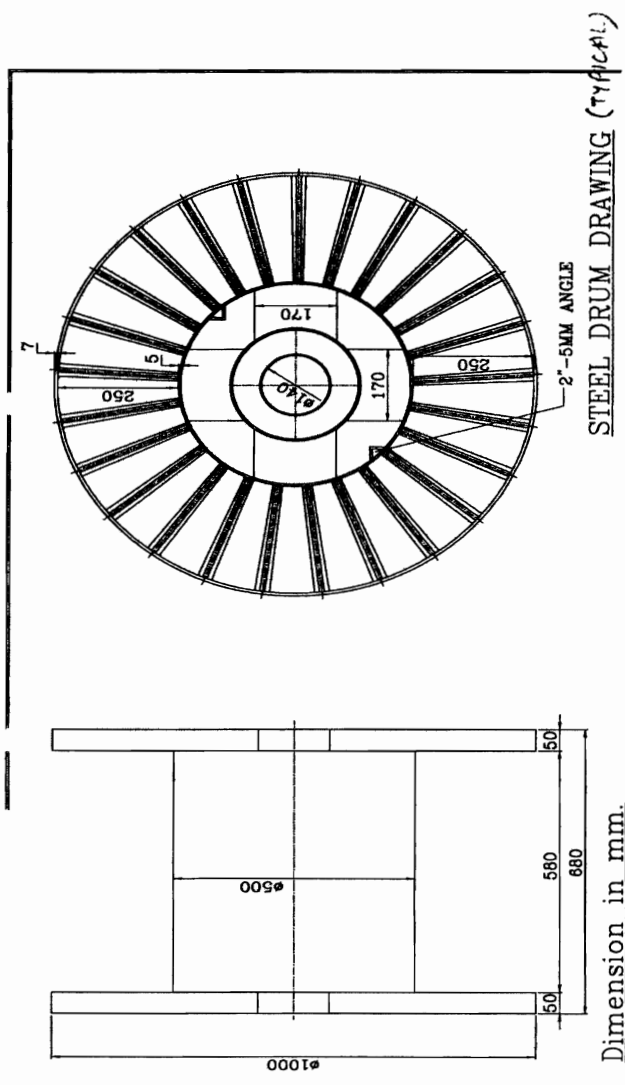
11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 40	OF 52



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 41	OF 52



11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 42	OF 52

- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

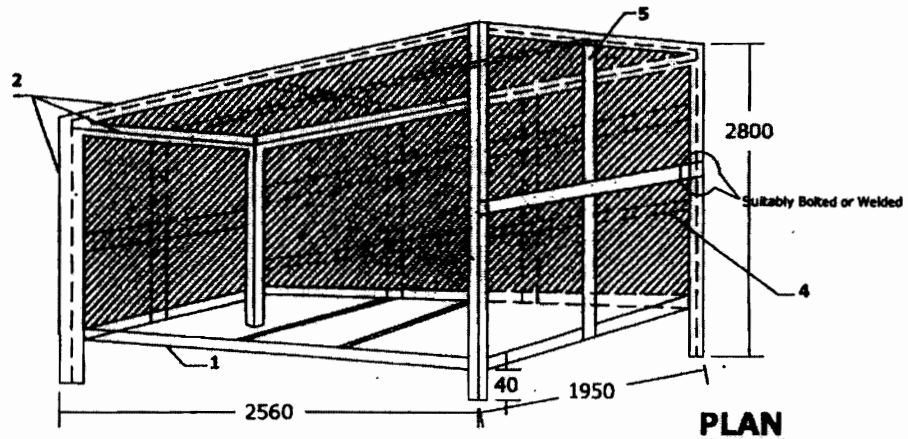
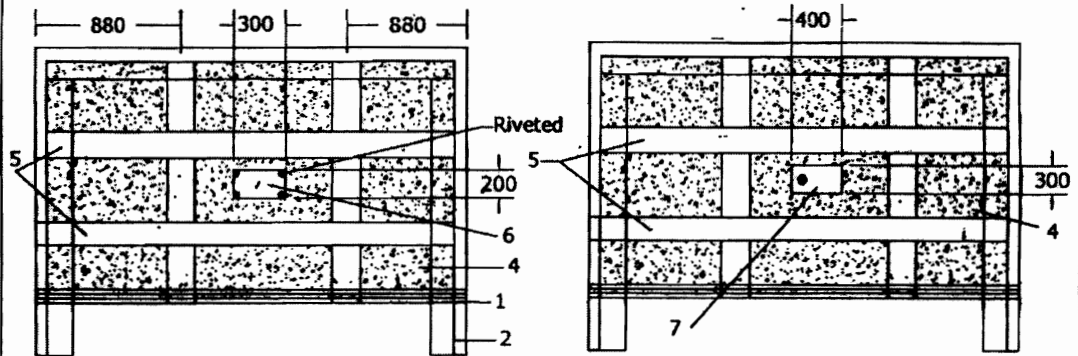
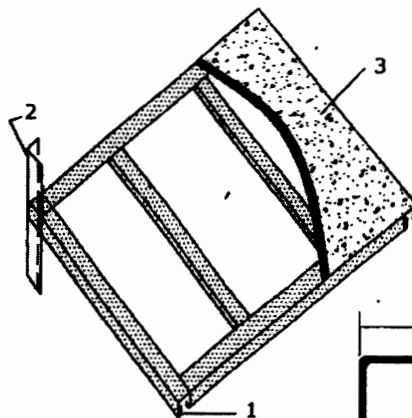
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

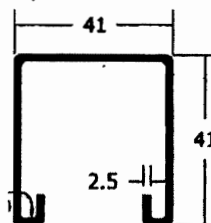
SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 43 OF 52

STEEL PACKING (TYPICAL DETAILS)**PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****BOTTOM FRAME ARRANGEMENT****Note:**

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.

**DETAILS OF "C" CHANNEL**

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 44	OF 52

11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

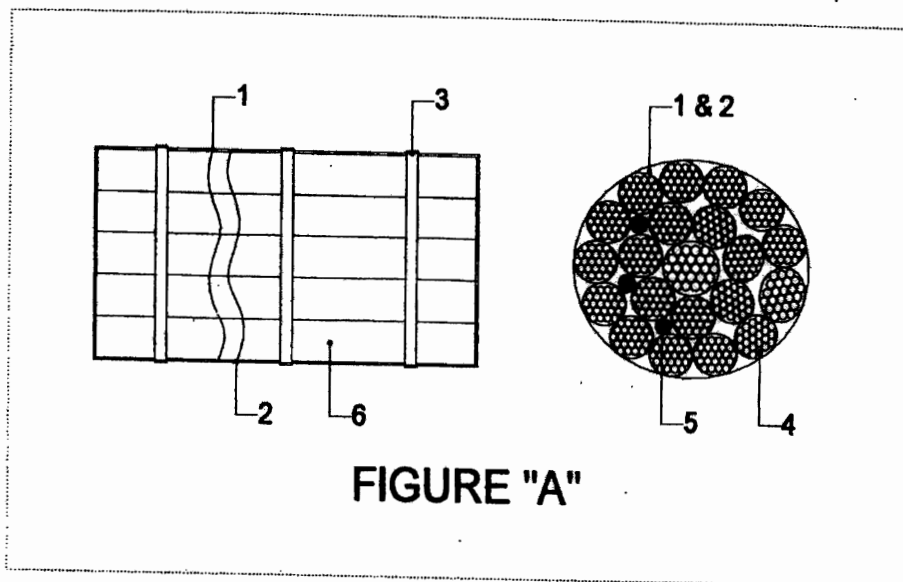
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 45	OF 52

Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 46	OF 52

PACKING PROCEDURE FOR CONDUIT PIPE



- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

**TITLE****TECHNICAL SPECIFICATION
FOR SEAWORTHY PACKING
FOR EXPORT JOBS**

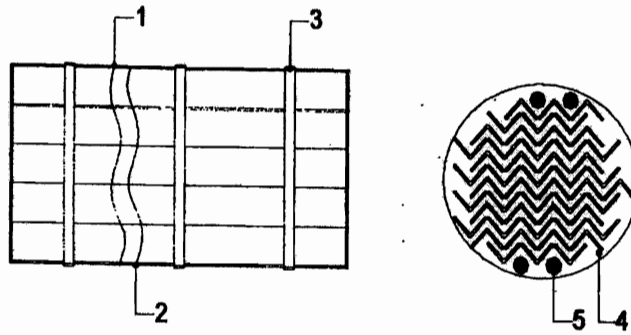
SPECIFICATION NO. PE-TS-888-100-A001

VOLUME II B

SECTION D

REV. NO. 0 DATE 10/08/2010

SHEET 47 OF 52

PACKING PROCEDURE FOR STRUCTURAL STEEL**FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.



TITLE

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

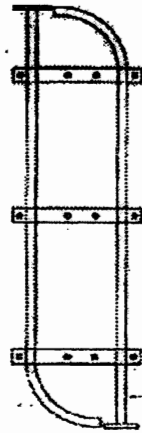
VOLUME II B

SECTION D

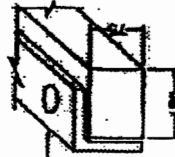
REV. NO. 0 DATE 10/08/2010

SHEET 48 OF 52

packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTRUDING COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH L50x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON L50x80x6 MM ANGLE

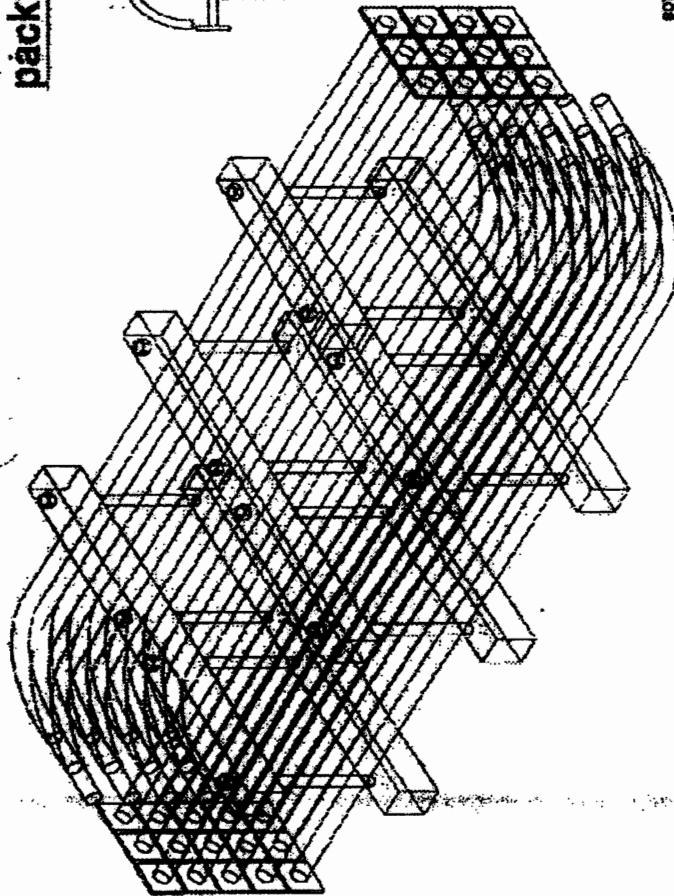


FIGURE "C"

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 49	OF 52

11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
 - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
 - ii) Hardware items shall be packed in polyethylene bags (Thickness $\geq 0.175\text{mm}$) with item slip
 - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
 - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
 - f) Galvanized Steel straps are provided for binding the packing box sides.
 - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 50	OF 52

- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001			
		VOLUME II B			
		SECTION D			
		REV. NO. 0	DATE 10/08/2010		
		SHEET	51	OF	52

- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 52	OF 52

useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

2) Class No. and Fluid Designation

CLASS NO.	FLUID NAME	SYMBOL	
AA60	Gypsum Slurry	GS	
	Filtrate Slurry	FS	
	Waste Water	WW	
	Duct Drain	DD	
	Beltfilter Vent Gas	VBG	
BA01	Instrument Air	AI	
	Lube Oil (Low Pressure)	LOL	
CC01	Process Water	WP	Note 1
	Raw Water	WR	
	Cooling Water Supply	WCS	
	Cooling Water Return	WCR	
	Vacuum Pump Vent	VG	
	Antifoam Agent	AA	

Note I

Class AA60 shall be applied for process water service line in contact with corrosive and abrasive media.

3) Abbreviations

Abbreviations used throughout this specification are as follows:

BB	:	Bolted Bonnet
BC	:	Bolted Cover
BE	:	Bevel End
BW	:	Butt Weld
CAL	:	Calculation
CR	:	Chloroprene Rubber
E	:	Electric Resistance Weld
EPDM	:	Ethylene Propylene Diene Methylene Rubber
Eq	:	Equal
FE	:	Flange End
FF	:	Flat Face
G. OP	:	Gear Operation
Gal.	:	Galvanized
HEX.	:	Hexagon
IIR	:	Isobutylene Isoprene Rubber

ISRS	:	Inside Screw Rising Stem
La	:	Larger
L.OP	:	Lever Operation
NB	:	Nominal Bore
NW	:	Nozzle Weld
OS&Y	:	Outside Screw & York
PE	:	Plane End
PP	:	Poly Propylene
PTFE	:	Poly Tetra Fluoro Ethylene
RF	:	Raised Face
R/L	:	Rubber lined or rubber seated
S	:	Seamless
SB	:	Screw Bonnet
SC	:	Screw Cover
SCH	:	Schedule No.
SCR'D	:	Screwed
Sm	:	Smaller
SO	:	Slip On
St.	:	Stelliting
SW	:	Socket Weld
W	:	Weld
WN	:	Welding Neck
W/LINING	:	With Lining
V#	:	Valve No.
13 CR	:	13% CHROMIUM

CLASS	Max. Press. (MPaG)		1.1		C. A. mm	CLASS
AA60 (1/1)	Max. Temp. (degC)		65			AA60 (1/1)
FLUID	GYPSUM SLURRY					
ITEM	Size	Thickness	Specification			ITEM No.
PIPING	DN25 – DN50	SCH40	A53-B SML PE (I:R/L) ASME			
	DN65 – DN150	SCH40	A53-B E. R. W BE (I:R/L) ASME			
	DN200 – DN300	SCH20	A53-B E. R. W BE (I:R/L) ASME			
	DN350 – DN400	SCH10	A53-B E. R. W BE (I:R/L) ASME			
	DN450 – DN500	SCH10	A53-B E. R. W BE (I:R/L) ASME			
	DN550 – DN1000	7.9T	A134 (A283-C) EFW BE (I:R/L) ASME			
	DN1100–DN1200	9.5T	A134 (A283-C) EFW BE (I:R/L) ASME			
FITTING	DN25 – DN50	Suit to PIPE	BW A234-WPB (I:R/L) ASME-B16.9			
	DN65 – DN150	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9			
	DN200 – DN300	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9			
	DN350 – DN500	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9			
	DN550 – DN1000	Suit to PIPE	BW A134 (A283-C) EFW (I:R/L) ASME-B16.9			
	DN1100–DN1200	Suit to PIPE	BW A134 (A283-C) EFW (I:R/L) ASME-B16.9			
SMOOTH BEND	DN25 – DN80	Suit to PIPE	BW A53-B (I:R/L)			
FLANGE	DN25 – DN600		SO A105 ASME150 SO FF (I:R/L) ASME-B16.5			
	DN650 – DN1800		SO A105 AWWA CL.B SO FF (I:R/L) AWWA-C207			
PINCH VALVE	DN25 – DN150		PN 16 A126-B TRIM-13CR SLEEVE-CR LINING-IIR FF HAND WHEEL			
GASKET	DN25 – DN600		V-2000 RUBBER RUBBER OR EQ. ASME150 2.0T FLAT RING			
	DN650 – DN1800		V-2000 RUBBER RUBBER OR EQ. AWWA CL.B 2.0T FLAT RING			
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR.B/A563-GR.A FINISHED			
Note: I: R/L - Replaceable Wear Resistant Natural Rubber Lining of minimum 6mm thickness. Additional thickness of 2 mm rubber lining shall be provided in bends.						

CLASS	Max. Press. (MPaG)	1		C. A. mm
BA01 (1/1)	Max. Temp. (degC)	45		
FLUID	INSTRUMENT AIR, LUBE OIL			
ITEM	Size	Thicknes s	Specification	
PIPING	DN6- DN50	SCH40S	A312-TP304 SML PE ASME	
	DN65-DN250	SCH20S	A312-TP304 E. R. W BE ASME	
FITTING	DN6 - DN50	Suit to PIPE	3000LB SW A182-F304 ASME-B16.11	
	DN65 - DN250		BW A403-WP304 ASME-B16.9	
FLANGE	DN6 - DN50	Suit to PIPE	SW GR. 304 GR. 304 ASME150 SW RF ASME-B16.5	
	DN65 - DN250		LOOSE A105 ASME150 LOOSE ASME-B16.5	
GATE VALVE	DN6 - DN50		API-602 PN 16 A182-F304 AISI304 SW BB, OS&Y HAND WHEEL	
	DN65 - DN250		ASME-B16.34 PN 16 A351-CF8 AISI304 RF BB, OS&Y HAND WHEEL	
GASKET	DN6 - DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 1.5T FLAT RING	
	DN200- DN250		V-6500 NON-ASBESTOS OR EQ. ASME150 3.0T FLAT RING	
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR. B/A563-GR. A FINISHED	

CLASS	Max. Press. (MPaG)	0.11	0.85		C. A. mm
CC01 (1/1)	Max. Temp. (degC)	155	45		
FLUID	WATER, VENT GAS				
ITEM	Size	Thickness	Specification		
PIPING	DN6 - DN50	SCH80	A53-B SML PE ASME		
	DN65 - DN150	SCH40	A53-B E. R. W BE ASME		
	DN200 - DN300	SCH20	A53-B E. R. W BE ASME		
FITTING	DN6 - DN50		3000LB SW A105 ASME-B16.11		
	DN65 - DN150	Suit to PIPE	BW A234-WPB ASME-B16.9		
	DN200 - DN300		BW A234-WPB ASME-B16.9		
FLANGE	DN6 - DN150	Suit to PIPE	SO A105 ASME150 SO RF ASME-B16.5		
	DN200 - DN300		SO A105 ASME150 SO RF ASME-B16.5		
GATE VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BB, OS&Y HAND WHEEL		
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BB, OS&Y HAND WHEEL		
GLOBE VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BB, OS&Y HAND WHEEL		
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BB, OS&Y HAND WHEEL		
CHECK VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BC, LIFT		
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BC, SWING		
BALL VALVE	DN6 - DN100		ASME-B16.34 PN16 A105 AISI304 RF BALL LEVER. FULL BORE		
BUTTERFLY VALVE	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER LEVER.		
	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER AIR CYLINDER W/L. SWITCH		
	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER ELECTRIC MOTOR W/L. SWITCH		
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER WHEEL WITH GEAR		
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER AIR CYLINDER W/L. SWITCH		
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER ELECTRIC MOTOR W/L. SWITCH		
GASKET	DN6 - DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 1.5T FLAT RING		
	DN200 - DN300		V-6500 NON-ASBESTOS OR EQ. ASME150 3.0T FLAT RING		
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR. B/A563-GR. A FINISHED		



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A001

SECTION: II

REV. 00

Page: 1 of 5

SECTION II
STANDARD TECHNICAL SPECIFICATION



3x660 MW NABINAGAR STPP
GYPHUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A001
SECTION: II
REV. 00
Page: 2 of 5

1.0 STANDARD TECHNICAL REQUIREMENTS – EQUIPMENTS/ COMPONENTS OF GDS

I	DESIGN CONSTRUCTION –VACUUM BELT FILTERS
1.	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.
2.	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material.
3.	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.
4.	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
5.	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.
6.	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.
7.	The service factor of the gear unit (if any) shall be minimum 1.5.
8.	Piping and wiring within the skid should be in the vendor's scope.
9.	Nozzles and connections The suction and discharge pipes will be flanged and will have the same nominal test procedure as the body of the pump. Threaded connections are not admitted in these pipes.
10.	The flanges shall comply with the following standards: - Steel flanges as per ANSI B16.5 (raised face type, at least class 150) - Cast iron flanges as per ANSI 16.1 (flat face type, at least class 125) The pipe shall be designed according to API676 with regards to the force.
II	DESIGN AND CONSTRUCTION OF VACUUM PUMPS
	Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.
a)	Pump Casing
	Pumps shall be radial split casing, close/semi-open, over-hang, end suction type back pull-out design, vertical discharge type for horizontal centrifugal pump. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A001
SECTION: II
REV. 00
Page: 3 of 5

b)	Impeller
	Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.
c)	Impeller/Casing Wearing Rings
	Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.
d)	Shaft
	The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.
e)	Shaft Sleeves
	Renewable type fine finished shaft sleeves shall be provided at mechanical seals. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.
f)	Bearings
	Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.
g)	Mechanical Seals
	Mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.
	The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.
h)	Pump Shaft Motor Shaft Coupling
	The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM

TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A001

SECTION: II

REV. 00

Page: 4 of 5

i)	Base Plate
	A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.
j)	Drive Motor (Prime Mover)
	The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.
III	GYPSUM DISCHARGE CHUTE
a)	The minimum valley angle of chutes shall be 60 degrees at the feeding point to guide the material in the direction of belt travel. Transfer chutes shall be adequately sized and sloped to ensure smooth flow of Gypsum without any accumulation anywhere.
b)	Chutes shall be made of minimum 20 mm thick TISCRAAL / SAILHARD/ LSLAS07 or equivalent material. All chutes should have one inspection door at every floor and for the ones in between the floors (more than 1.5 meter above the operating floor level) suitable access for trouble free maintenance shall be provided. For sealing of inspection doors labyrinth type arrangement to be provided.
c)	Complete chute work in the region of flap gates shall be fabricated from 20 thk TISCRAAL or equivalent. In case of vertical chute (valley angle more than 80 degree) complete chute, work shall be of 20 mm thick TISCRAAL or equivalent material. While finalizing the chute work inside the building, arrangement for shifting and replacing chute legs, proper handling arrangement/wall openings, trolleys, hoists shall also be provided. While fabricating the chute, no welds in between shall be allowed.
	One (1) no. chute blockage switch for each belt filter of proven type (subject to approval of the employer) shall be provided. Chute blockage switch shall trip the feeding conveyor in case of Chute blockage and protect the feeding conveyor equipment.
IV	PIPING
a)	The slurry pipes shall be sized to minimize erosion and avoid settling of the gypsum at all load operation. Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The bidder may provide a recirculation line with motorized isolation valve for the above purpose. All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. The bidder can provide slurry pipes of size lower than 300 NB made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. Outer surface of the pipes should be fire retardant. All the rubber-lined pipes shall be of flanged connection.
b)	Valves shall be of proven type and type contractor shall submit details valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.
c)	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.
d)	Necessary arrangements for purging & flushing of all the process pipelines, equipments etc. shall be required.
e)	Belt filter washing pumps shall have a minimum flow line to tank with a restriction orifice.



3x660 MW NABINAGAR STPP
GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-457-571-A001

SECTION: II

REV. 00

Page: 5 of 5

f)	All Lube oil , Instrument Air piping shall be made up of Gr.304 Stainless Steel material.
g)	All process water & Cooling water piping shall be made up of Carbon Steel Pressure Piping.
V	PROCESS/CLARIFIED WATER PUMPS
a)	The cake/cloth wash pumps shall be horizontal centrifugal type designed for continuous operation with semi-open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.
VI	GENERAL
a)	Cake/Cloth Wash pump shall be 1500/3000 RPM. The Vacuum Pump is a low speed machine and the RPM shall be selected by the bidder meeting the system requirement. Bidder to note that above shall be subject to BHEL/BHEL's Customer approval during contract stage.
b)	For gypsum, the bulk density shall be taken as 900 kg/m ³ for volumetric computation and 1250 kg/m ³ for torque and drive requirements. Refer respective P&IDs for Slurry details.
c)	The slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized 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.
d)	The slurry pump casing should be radially split to allow easy removal of impeller.



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 1

REV: 00

SHEET 1 OF 1

ANNEXURE - 1

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder should submit the filled up (wherever applicable), signed and stamped copy of the following documents along with the offer/ bid for technical evaluation:

Sl. No.	Reference	Description
1.	Annexure-2	COMPLIANCE CUM CONFIRMATION CERTIFICATE
2.	Annexure-3	PRE BID CLARIFICATION SCHEDULE
3.	Annexure-4	DEVIATION SHEET (COST OF WITHDRAWAL)
4.	Annexure-5	SCHEDULE OF GUARANTEES
5.	Annexure-6	LIST OF MAKES OF SUB VENDOR ITEMS
6.	Annexure-7	LIST OF TOOLS & TACKLES
7.	Annexure-8	EQUIPMENT DATA SHEET/ SCHEDULE (TO BE FILLED BY BIDDER)
8.	Annexure-9	LIST OF COMMISSIONING SPARES
9.		UNPRICED SCHEDULE IN THE PRICE FORMAT ISSUED ALONG WITH TENDER

	3x660 MW NABINAGAR STPP	SPECIFICATION No: PE-TS-457-571-A101
	GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION COMPLIANCE CUM CONFIRMATION CERTIFICATE	SECTION : III
		ANNEXURE : 2
		REV. NO. 00
		SHEET: 1 OF 2

COMPLIANCE-CUM-CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer, if not sought/required for bid evaluation shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements, the same shall be resolved by the bidder during the pre-bid discussions, otherwise BHEL/Customer's decision shall be binding on the bidder, whenever the deficiency is pointed out.

For components where materials are not specified, the same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same are deemed to be included in the base price.
- g) All sub-vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee/Warranty for plant/equipment shall be as per relevant clause of GCC / SCC / other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break-up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

	3x660 MW NABINAGAR STPP GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-457-571-A101
		SECTION : III
		ANNEXURE : 2
		REV. NO. 00
		SHEET: 2 OF 2
commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account. j) Schedule of drawings/documents/quality plans submission, comment incorporation & approval shall be as stipulated elsewhere in the specification. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time. k) As-built drawings shall be submitted as and when required during the project execution. l) The bidder has not tampered with this compliance-cum-confirmation certificate and if at any stage any tampering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder. m) Successful bidder shall furnish detailed erection/installation manual for each of the equipment supplied under this contract as per the schedule of submission of documents and well before the scheduled erection of the equipment / component concerned. n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and shall require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement. o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.		



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION : III

ANNEXURE : 3

REV. NO. 00

PRE-BID CLARIFICATION SCHEDULE

SHEET: 1 OF 1

ANNEXURE-3

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

DEVIATION SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 4

REV: 00

SHEET 1 OF 1

DEVIATION SHEET (COST OF WITHDRAWAL)

**(TO BE FILLED UP BY BIDDER IN THE FORMAT ATTACHED AS
ANNEXURE –II OF GENERAL CONDITIONS OF CONTRACT ISSUED
ALONG WITH TENDER. ANY DEVIATION QUOTED ELSEWHERE/ IN
OTHER FORMAT SHALL NOT BE CONSIDERED)**



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SCHEDULE OF GUARANTEES

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 5

REV: 00

SHEET 1 OF 2

SCHEDULE OF GUARANTEES



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION : III

ANNEXURE : 5

REV: 00

SCHEDULE OF GUARANTEES

SHEET 2 OF 2

1.0 PERFORMANCE GUARANTEE

All performance tests for GDS shall be carried out in accordance with the relevant latest international codes/standards.

- 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Gypsum Dewatering System (GDS) and its accessories.
- 2) Bidder shall furnish guaranteed power consumption for the gypsum dewatering system. Guaranteed Power Consumption in the applicable format shall be submitted in sealed envelope along with price bid as part of techno-commercial offer. However along with unpriced format, bidder shall furnish guaranteed power consumption format indicating "Quoted" in the table provided in Annexure-IV of the price schedule.
- 3) Vendor shall Guarantee and demonstrate each Vacuum Belt Filter capacity of minimum 65.3 TPH wet gypsum cake with an inlet solid concentration of 45% by weight.
- 4) The contractor shall guarantee and demonstrate that gypsum cake moisture content shall not be more than 10% and chloride content shall not be more than 100 ppm. Purity of gypsum shall be 90% or more.
- 5) The filter cloth shall be guaranteed for a minimum life of not less than 7000 hrs.
- 6) The liners in hydro-cyclone shall have a minimum wear life of not less than 7000 hrs.
- 7) Noise level ≤ 85 dB (A) at 1 m horizontal distance from equipment/enclosures & 1.5 m above operating floor is to be guaranteed.
- 8) Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
- 9) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ PVUNL approval.
- 10) In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.

Bidder shall submit signed & stamped copy of this document.



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION

SUB-VENDOR LIST

SPECIFICATION NO. PE-TS-457-571-A101

SECTION : III

ANNEXURE : 6

REV 00

SHEET 1 OF 1

LIST OF MAKES OF ITEMS

S.N.	ITEM NAME	MANUFACTURER	LOCATION



3x660 MW NABINAGAR STPP

TECHNICAL SPECIFICATION
GYPSUM DEWATERING SYSTEM

LIST OF SPECIAL TOOLS & TACKLES

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 7

REV 00

SHEET 1 OF 1

LIST OF SPECIAL TOOLS & TACKLES

S.N.	ITEMS	QUANTITY



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 1 OF 8

EQUIPMENT DATA SHEET/SCHEDULE

S.No.	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-PEM, Noida
	b. Project	: NPGCPL Nabinagar 3x660 MW
	c. End Customer	: NPGCPL/NTPC
	d. Location	: Aurangabad, Bihar
	e. Service	: Continuous
	f. Installation	: Inside the Building
	g. Quantity for all 3 FGD units	: 2 sets (1W+1S)
2.0	MANUFACTURER DETAILS	
	a. Model	: Bidder to Provide
	b. Type	: Bidder to Provide
3.0	OPERATING CONDITION	
	Medium to be handled	: Gypsum Slurry
4.0	Technical Data	
4.1	PRIMARY HYDRO-CYCLONE	
	i. Stage	Bidder to Provide
	ii. Manufacturer	Bidder to Provide
	iii. Number of Hydro cyclone	Bidder to Provide
	iv. Diameter of Hydro cyclone	Bidder to Provide
	v. Diameter of Vortex Finder	Bidder to Provide
	vi. Diameter of Apex Valve	Bidder to Provide
	vii. Diameter of Feed Inlet	Bidder to Provide
	viii. Design Pressure	Bidder to Provide
	ix. Working Pressure	Bidder to Provide
	x. Feed Flow rate	Bidder to Provide
	xi. Overflow Rate	Bidder to Provide
	xii. Underflow Rate	Bidder to Provide
	xiii. Mesh of separation (50% Removed)	Bidder to Provide



3x660 MW NABINAGAR STPP

SPECIFICATION No: PE-TS-457-571-A101

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

SECTION : III

ANNEXURE : 8

REV 00

EQUIPMENT DATA SHEET/SCHEDULE

SHEET 2 OF 8

	xiv.	Solid content of feed slurry	Bidder to Provide		
	xv.	Solid content in underflow of Hydrocyclone	Bidder to Provide		
	xvi.	Solid content in Overflow of Hydrocyclone	Bidder to Provide		
	xvii.	Type of cyclone	Bidder to Provide		
	a)	Cyclone Dia/Height (mm)	Bidder to Provide		
	b)	Required Liquid Feed Pressure	Bidder to Provide		
	c)	Cyclone Connection Number/Dia. (mm)	Bidder to Provide		
	d)	Feed	Bidder to Provide		
	e)	Overflow	Bidder to Provide		
	f)	Underflow	Bidder to Provide		
	g)	Rf Value (Underflow Slurry (m3/hr/Feed	Bidder to Provide		
	h)	Material	Bidder to Provide		
	i)	Shell	Bidder to Provide		
	j)	Internal Structure Part	Bidder to Provide		
	k)	Lining	Bidder to Provide		
	l)	Particle Size Distribution	Bidder to Provide		
	m)	Weight	Bidder to Provide		
4.2	VACUUM BELT FILTERS (VBF)				
	a.	Manufacturer	:	Bidder to Provide	
	b.	Model No.	:	Bidder to Provide	
	c.	Dimensions (W x L x H) (m x m x m)	:	Bidder to Provide	
	d.	Cloth Width	m	:	Bidder to Provide
	e.	Cloth Length	m	:	Bidder to Provide
	f.	No. Working / Stand-by	:	Bidder to Provide	
	g.	Capacity (Guaranteed) Gypsum (Dry)	Kg/hr	:	Bidder to Provide
	h.	Inlet Flow Volume	m3/h	:	Bidder to Provide
	i.	Gypsum Flow (Dry)	Kg/hr	:	Bidder to Provide



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 3 OF 8

j.	Moisture Removed	%	:	Bidder to Provide
k.	No. of stages of cake washing / water flow	m3/h	:	Bidder to Provide
l.	No. of stages of cloth washing / water flow	m3/h	:	Bidder to Provide
m.	Design Pressure of Vacuum Chamber		:	Bidder to Provide
n.	Operating Pressure of Vacuum Chamber		:	Bidder to Provide
o.	Material / Thickness	mm	:	Bidder to Provide
i.	Casing		:	Bidder to Provide
ii.	Cloth		:	Bidder to Provide
iii.	Gypsum Discharge Hopper		:	Bidder to Provide
iv.	Vacuum Box		:	Bidder to Provide
p.	Life of Cloth	hrs	:	Bidder to Provide
q.	Type /Material of Carrying Belt		:	Bidder to Provide
r.	Type / Material of Sealing Belt		:	Bidder to Provide
s.	Life of Carrying Belt	hrs	:	Bidder to Provide
t.	Life of Sealing Belt	hrs	:	Bidder to Provide
u.	Automatic Cloth Tensioning Mechanism Provided		:	Yes / No - Bidder to confirm
4.3	VACUUM RECEIVER TANK			
a.	No. of Tank for each VBF		:	Bidder to Provide
b.	Capacity (m3)		:	Bidder to Provide
c.	Dimensions (Dia x Height) (mm x mm)		:	Bidder to Provide
d.	Material / Thickness (mm)		:	Bidder to Provide
e.	Lining Material / Thickness mm		:	Bidder to Provide
4.4	Vacuum Pumps			
a.	Manufacturer		:	Bidder to Provide
b.	Make/Model		:	
c.	Type		:	Bidder to Provide
d.	No. of Pumps for each Vacuum Belt Filter		:	Bidder to Provide
e.	Rated Capacity Flow (m ³ /hr)		:	Bidder to Provide



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 4 OF 8

	Rated Capacity Head (mWCI)	:	Bidder to Provide
	Rated Capacity Power (KW)	:	Bidder to Provide
f.	Power consumption (KW)	:	Bidder to Provide
g.	Pump Speed (rpm)	:	Bidder to Provide
h.	Motor Rating (KW)	:	Bidder to Provide
i.	Motor Speed (rpm)	:	Bidder to Provide
j.	Margins (Flow/Head) (%/%)	:	Bidder to Provide
k.	Operation Pressure	:	Bidder to Provide
l.	Design Pressure	:	Bidder to Provide
m.	Material/Thickness (mm) of	:	Bidder to Provide
	Base/Lining	:	Bidder to Provide
	Casing	:	Bidder to Provide
	Shaft	:	Bidder to Provide
	Impeller	:	Bidder to Provide
n.	Type of seal	:	Bidder to Provide
o.	Sealing Water Flow (m3/hr)	:	Bidder to Provide
p.	Bearing	:	Bidder to Provide
	No. of Bearings	:	Bidder to Provide
	Type Of Bearings	:	Bidder to Provide
q.	Type of coupling	:	Bidder to Provide
r.	Whether silencer provided at outlet	:	Yes/No
4.5	SLURRY PIPES	:	
a.	Pipe size (mm)	:	Bidder to Provide
b.	Type of Joints	:	Bidder to Provide
	Pipe to Pipe/Pipe to Fittings	:	Bidder to Provide
	Fittings	:	Bidder to Provide
c.	Material / Thickness (mm)of Pipe	:	Bidder to Provide
d.	Material Thickness of lining	:	Bidder to Provide
e.	Estimated Life of liners (hrs.)	:	Bidder to Provide
f.	Slurry Solid concentration (w/w %)	:	Bidder to Provide



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 5 OF 8

g.	Slurry Settling Velocity (m/s)		Bidder to Provide
h.	Pipe Velocity (m/s)		Bidder to Provide
4.6	BELT FILTER WASH PUMPS		
a.	No. for each VBF		
b.	No. of stand-by pumps for each VBF		
c.	Make / Model		
d.	Impeller Type		
e.	Material / Thickness (mm) of Impeller and lining		
f.	Casing Type		
g.	Material/Thickness of Casing/Lining		
h.	Rated Flow/Head (m3/hr./mWCI)		
4.7	CAKE WASH PUMPS		
i.	No. for each VBF		
j.	No. of stand-by pumps for each VBF		
k.	Make / Model		
l.	Impeller Type		
m.	Material / Thickness (mm) of Impeller and lining		
n.	Casing Type		
o.	Material/Thickness of Casing/Lining		
p.	Rated Flow/Head (m3/hr./mWCI)		
4.8	BELT ACCESSORIES		
4.8.1	Bearing		
a.	Carrying	:	Bidder to Provide
b.	Return	:	Bidder to Provide
4.8.2	Material		
a.	Roller	:	Bidder to Provide
b.	Spindle	:	Bidder to Provide
4.8.3	Pulleys		
i)	General (for all types of Pulleys)	:	Bidder to Provide
a.	Pulley Shaft Diameter	:	Bidder to Provide



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 6 OF 8

ii)	Drive Pulleys		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
c.	Minimum angle of wrap	:	Bidder to Provide
d.	Maximum out of roundness	:	Bidder to Provide
iii)	Other Pulleys		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
iv)	Rubber for lagging		
a.	Type	:	Bidder to Provide
b.	Hardness	:	Bidder to Provide
c.	Elongation	:	Bidder to Provide
d.	Strength	:	Bidder to Provide
e.	Abrasion Loss	:	Bidder to Provide
f.	Specific Gravity	:	Bidder to Provide
g.	Adhesion Strength	:	Bidder to Provide
v)	Bearings for Pulleys		
a.	Type	:	Bidder to Provide
b.	Casing	:	Bidder to Provide
c.	Sealing	:	Bidder to Provide
d.	Lubrication	:	Bidder to Provide
e.	Pulley Material	:	Bidder to Provide
f.	Shaft Material	:	Bidder to Provide
4.9	Chutes and Hoppers		
a.	Minimum Valley Angle	:	Bidder to Provide
b.	Material :	:	Bidder to Provide
	i) Chute work	:	Bidder to Provide
	ii) Sliding zones & adjacent sides	:	Bidder to Provide
	iii) No striking/ Non sliding zones	:	Bidder to Provide



3x660 MW NABINAGAR STPP

GYPSUM DEWATERING SYSTEM TECHNICAL SPECIFICATION

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 7 OF 8

	iv) Chute with valley angle 80 degree and above	:	Bidder to Provide
	v) In the zone of magnetic field	:	Bidder to Provide
	vi) In the zone of flap gates	:	Bidder to Provide
	vii) Discharge Hoods overhead pulleys	:	Bidder to Provide
c.	Inspection Doors	:	Bidder to Provide
d.	Chute Construction	:	Bidder to Provide
	i) Corners	:	Bidder to Provide
	ii) Joints Bolted	:	Bidder to Provide
	iii) Bolt size	:	Bidder to Provide
	iv) Bolts spacing	:	Bidder to Provide
	v) Fixing Arrangement	:	Bidder to Provide
4.9.	Skirt Boards		
a.	Length	:	Bidder to Provide
b.	Height	:	Bidder to Provide
c.	Width	:	Bidder to Provide
	Side plate		
4.9	Secondary (Waste Water) Hydrocyclone	:	Bidder to Provide
	i) Stage	:	Bidder to Provide
	ii) Manufacturer	:	Bidder to Provide
	iii) Number of Hydrocyclone	:	Bidder to Provide
	iv) Diameter of Hydrocyclone	:	Bidder to Provide
	v) Diameter of Vortex Finder	:	Bidder to Provide
	vi) Diameter of Apex Valve	:	Bidder to Provide
	vii) Diameter of Feed Inlet	:	Bidder to Provide
	viii) Design Pressure	:	Bidder to Provide
	ix) Working Pressure	:	Bidder to Provide
	x) Feed Flow rate	:	Bidder to Provide
	xi) Overflow Rate	:	Bidder to Provide
	xii) Underflow Rate	:	Bidder to Provide
	xiii) Mesh of separation (50% Removed)	:	Bidder to Provide
	xiv) Solid content of feed slurry	:	Bidder to Provide



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

EQUIPMENT DATA SHEET/SCHEDULE

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 8

REV 00

SHEET 8 OF 8

	xv) Solid content in underflow of Hydro-cyclones	:	Bidder to Provide
	xvi) Solid content in Overflow of Hydro-cyclones	:	Bidder to Provide
	xvii) Type of cyclone	:	Bidder to Provide
	a. Cyclone Dia/Height (mm)	:	Bidder to Provide
	b. Required Liquid Feed Pressure	:	Bidder to Provide
	c. Cyclone Connection Number/Dia. (mm)	:	Bidder to Provide
	d. Feed	:	Bidder to Provide
	e. Overflow	:	Bidder to Provide
	f. Underflow	:	Bidder to Provide
	g. Rf Value (Underflow Slurry (m ³ /hr/Feed Slurry (m ³ /hr)	:	Bidder to Provide
	h. Material	:	Bidder to Provide
	i. Shell	:	Bidder to Provide
	j. Internal Structure Part	:	Bidder to Provide
	k. Lining	:	Bidder to Provide
	l. Particle Size Distribution	:	Bidder to Provide
	m. Weight	:	Bidder to Provide



3x660 MW NABINAGAR STPP

**GYPSUM DEWATERING SYSTEM
TECHNICAL SPECIFICATION**

LIST OF COMMISSIONING SPARES

SPECIFICATION No: PE-TS-457-571-A101

SECTION : III

ANNEXURE : 9

REV 00

SHEET 1 OF 1

LIST OF COMMISSIONING SPARES

S.N.	ITEMS	QUANTITY